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FROM

Mrs Charles S. Peirce

DARWINISM
ILLUSTRATED

WOOD-ENGRAVINGS

EXPLANATORY OF THE

THEORY OF EVOLUTION

SELECTED BY AND DRAWN UNDER THE DIRECTION OF

PROF. GEORGE J. ROMANES

CHICAGO:
THE OPEN COURT PUBLISHING COMPANY
1892.

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PUBLISHERS' PREFACE.

THIS collection of wood-engravings, made under the direction of Professor George J. Romanes, illustrates his view of the theory of organic evolution. We here survey at a glance a number of instructive facts, so arranged that we can understand the truth of Darwinism as it were by intuition.

Most of the illustrations are new and original: they have been drawn by artists under the personal supervision of Professor Romanes. Others have been added from different sources, and Professor Romanes has taken pains to incorporate into this collection the most valuable and instructive drawings he could find.

PREFACE.

SEVERAL years ago Lord Rosebery founded, in the University of Edinburgh, a lectureship on "The Philosophy of Natural History," and I was invited by the Senatus to deliver the lectures. I accepted the invitation, and subsequently constituted the material of my lectures the foundation of another course, which was given in the Royal Institution, under the title "Before and after Darwin." Here the course extended over three years—namely from 1888 to 1890. The lectures for 1888 were devoted to the history of biology from the earliest recorded times till the publication of the "Origin of Species" in 1859; the lectures for 1889 dealt with the theory of organic evolution up to the date of Mr. Darwin's death, in 1882; while those of the third year discussed the further developments of this theory from that date till the close of the course in 1890.

It is from these two courses—which resembled each other in comprising between thirty and forty lectures, but differed largely in other respects—that a special treatise has grown which is soon to be published under the title "Darwin and after Darwin." The present engravings were collected for this special purpose and their detailed explanation will be found in the forthcoming book.

My obligations to the Senatus of the University of Edinburgh, and to the Board of Management of the Royal Institution, have already been virtually expressed; but I should like to take this opportunity of also expressing my obligations to the students who attended the lectures in the University of Edinburgh. For alike in respect of their large numbers, their keen intelligence, and their generous sympathy, the members of that voluntary class yielded a degree of stimulating encouragement, without which the labor of preparing the original lectures could not have been attended with the interest and the satisfaction that I found in it.

My thanks are also due to *Mr. R. E. Holding* for the painstaking manner in which he has assisted me in executing most of the original drawings of the present collection.

Lastly I must mention that I am indebted to Professors Le Conte, Cope, Heilprin, Marsh, Mr. and Mrs. Peckham, and the widow of the late Prof. Leidy, for kindly allowing me to use a number of their illustrations, not only in my English edition of "Darwin and After Darwin" but also in American publications.

CHRIST CHURCH, OXFORD, G. J. R.
April 19*th*, 1892.

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DARWINISM ILLUSTRATED.

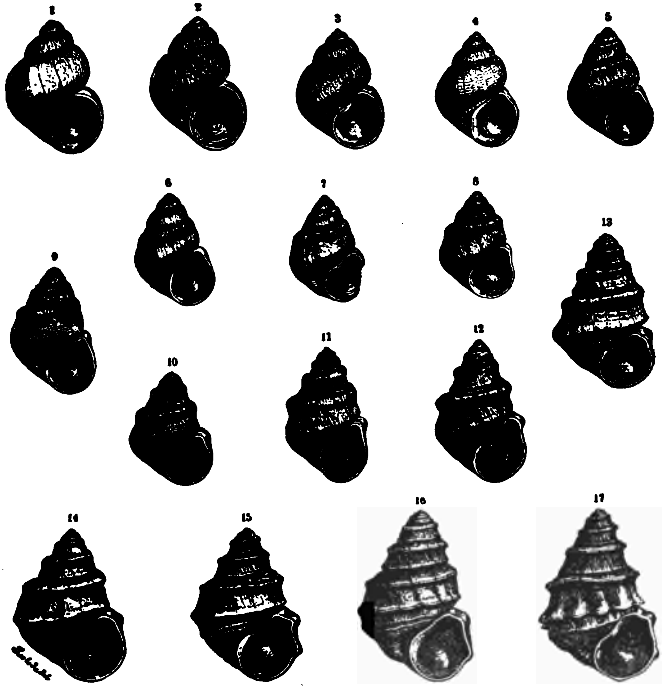


FIG. I.—Successive forms of Paludina, from the Tertiary deposits of Slavonia (after Neumayr).

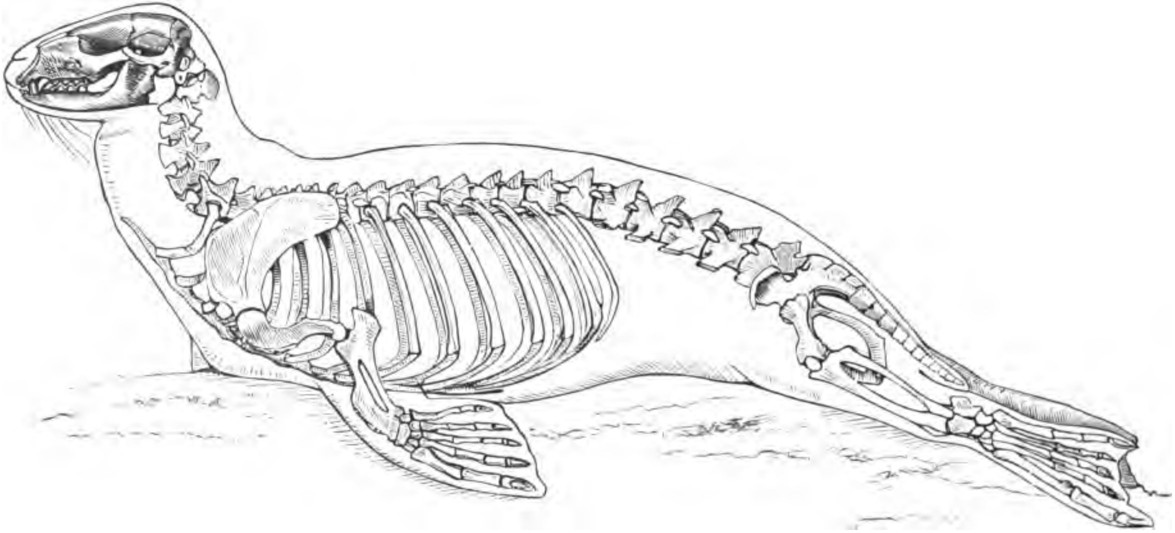


FIG. 2.—Skeleton of Seal, ⅛ nat. size. Drawn from nature (*R. Coll. Surg. Mus.*)

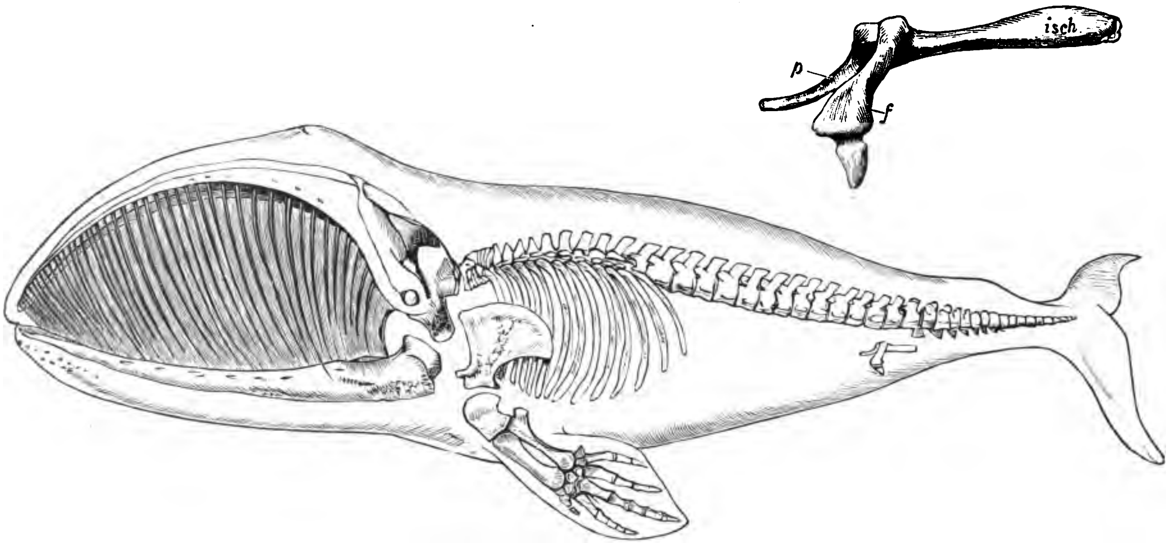


FIG. 3—Skeleton of Greenland Whale, $\frac{1}{100}$ nat. size. The rudimentary bones of the pelvis are shown on a larger scale in the upper drawing. (From Prof. Flower.)

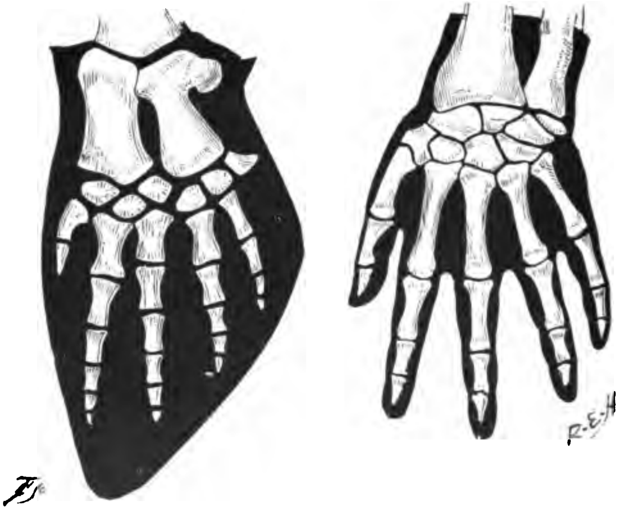


FIG. 4 —Paddle of Whale compared with Hand of Man. Drawn from nature (*R. Coll. Surg. Mus*)

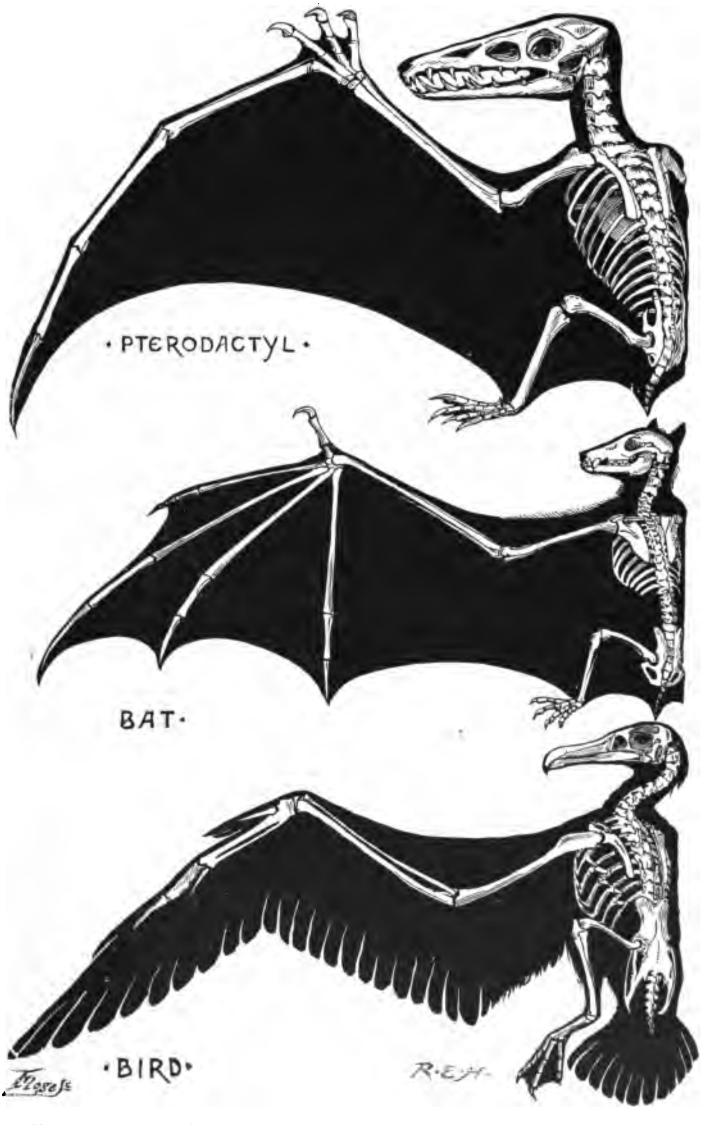


FIG. 5.—Wing of Reptile, Mammal, and Bird. Drawn from nature (*Brit. Mus.*)

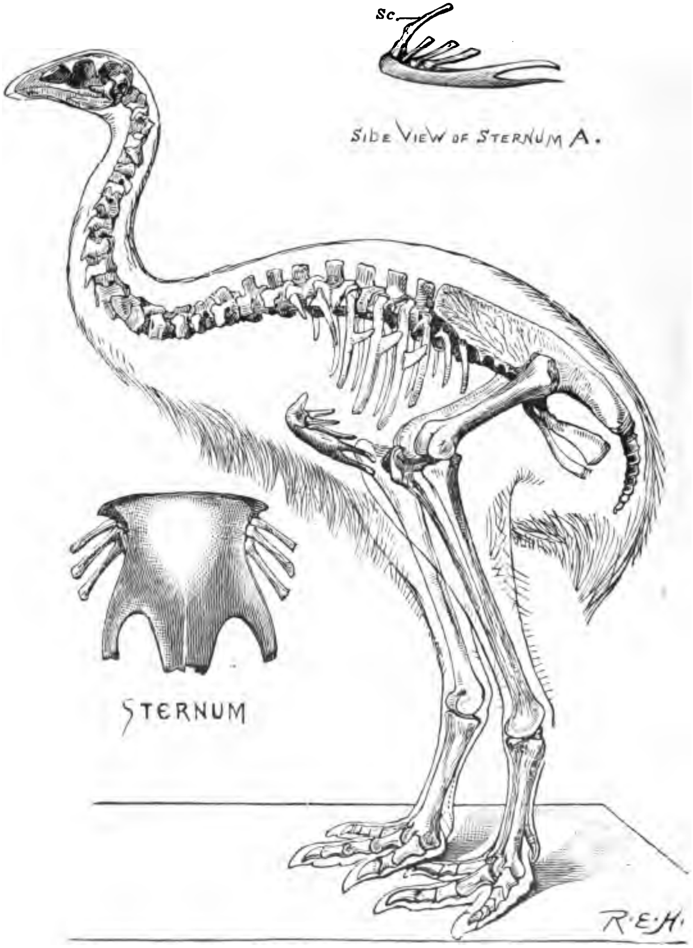

Sc
SIDE VIEW OF STERNUM A.
STERNUM
R·E·H·

FIG. 6.—Skeleton of *Dinorsis gravis*, $\frac{1}{18}$ nat. size. Drawn from nature (*Brit. Mus.*) As separate cuts on a larger scale are shown, 1st, the sternum, as this appears in mounted skeletons, and, 2nd, the same in profile, with its (hypothetical) scapulo coracoid attached.

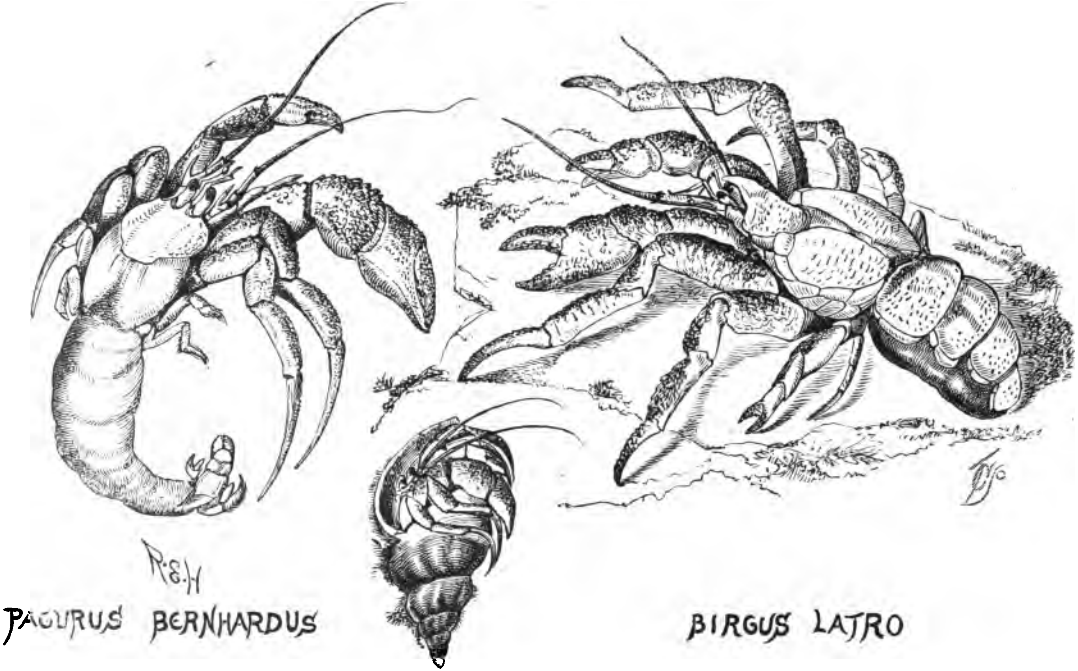


FIG. 7.—Hermit-crabs compared with the cocoa-nut crab. On the left of the illustration one hermit-crab is represented as occupying a mollusk-shell, and another (larger specimen) as it appears when withdrawn from such a shell. On the right of the illustration the cocoa-nut crab is represented in its natural habitat on land. When full-grown, however, it is much larger than our hermit-crabs. The latter are drawn from life, natural size, the former from a specimen in the British Museum, $\frac{1}{8}$ natural size.

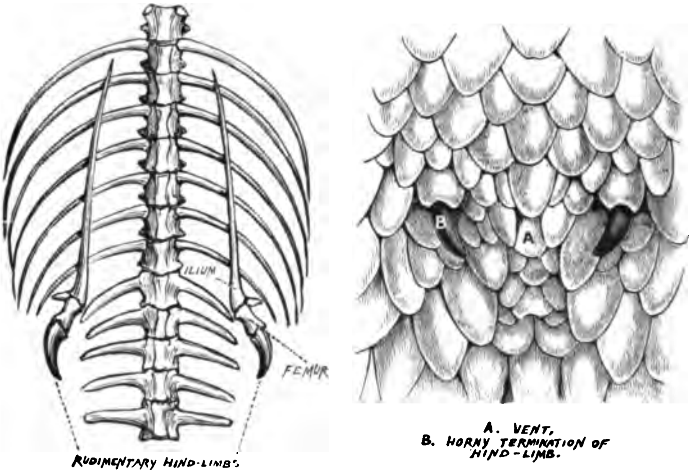


FIG. 8.—Rudimentary or vestigial hind limbs of Python, as exhibited in the skeleton and on the external surface of the animal. Drawn from nature, ¼ nat. size (*Zoological Gardens*).

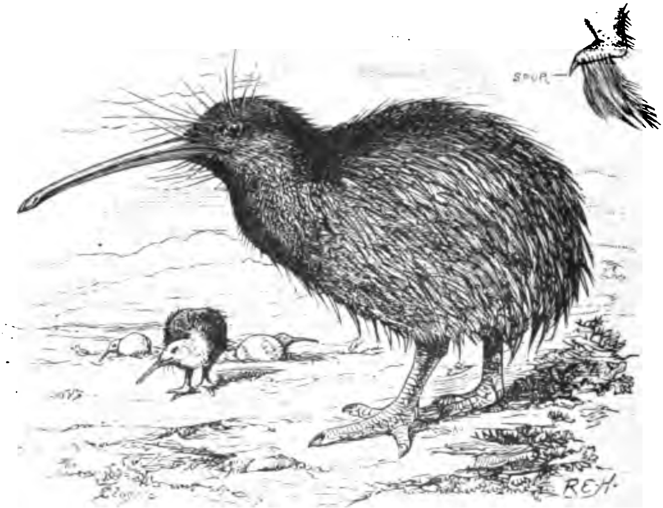


FIG. 9 —*Apteryx Australis.* Drawn from life in the Zoological Gardens ⅙ nat size. The external wing is drawn to a scale in the upper part of the cut. The surroundings are supplied from the most recent descriptions.

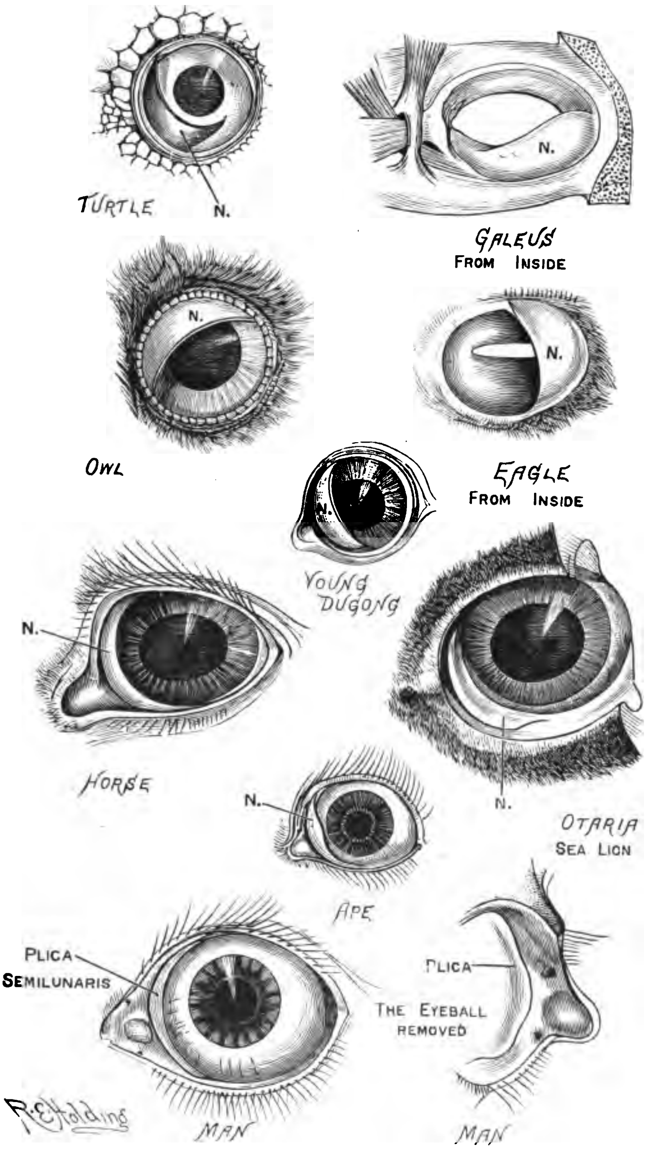


FIG. 10.—Illustrations of the nictitating membrane in the various animals named, drawn from nature. The letter N indicates the membrane in each case. In man it is called the *plica semilunaris*, and is represented in the two lower drawings under this name. In the case of the shark (*Galeus*) the muscular mechanism is shown as dissected.

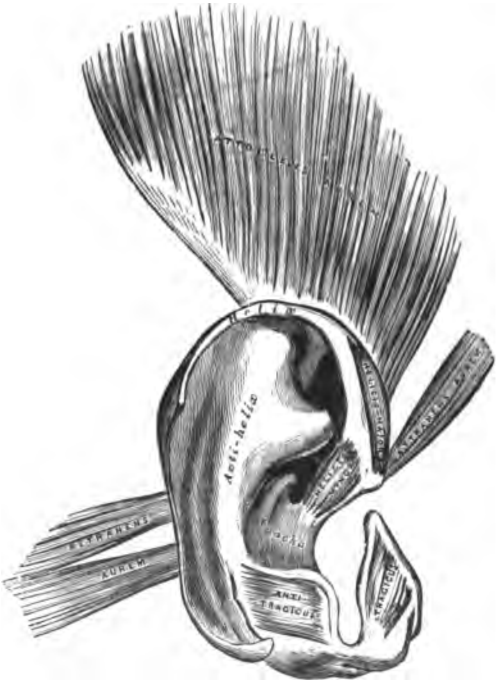


FIG. 11.—Rudimentary, or vestigial and useless, muscles of the human ear. (From *Gray's Anatomy*).

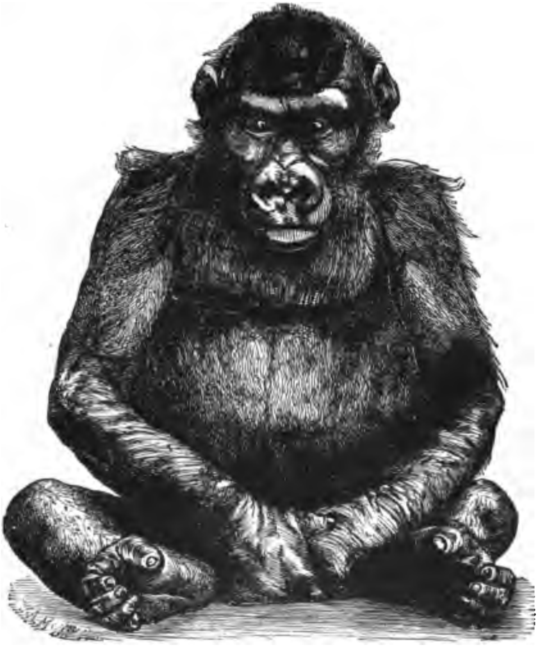


FIG. 12.—Portrait of a young male gorilla (after Hartmann).

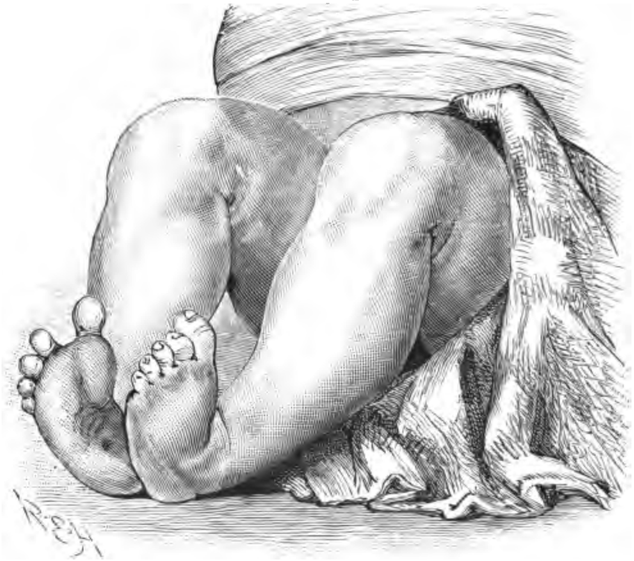


FIG. 13.—Lower extremities of a young child. Drawn from life, when the mobile feet were for a short time at rest in a position of extreme inflection.

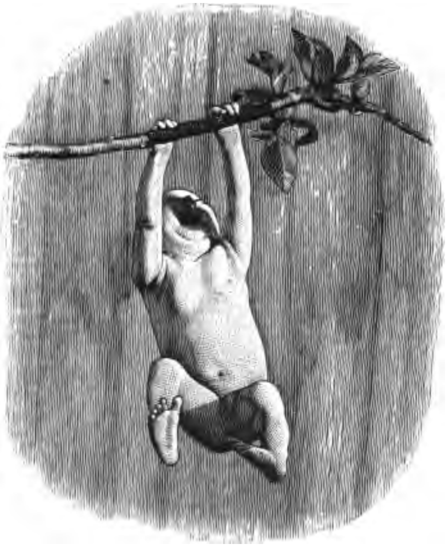


FIG. 14.—An infant three weeks old, supporting its own weight for over two minutes. The attitude of the lower limbs, feet, and toes, is strikingly simian. Reproduced from an instantaneous photograph, kindly given for the purpose by Dr. L. Robinson.

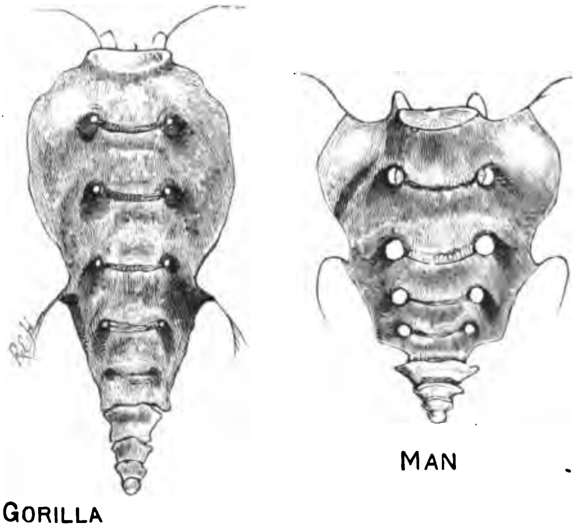


FIG. 15.—Sacrum of Gorilla compared with that of Man, showing the rudimentary tail bones of each. Drawn from nature (*R. Coll. Surg Mus.*)

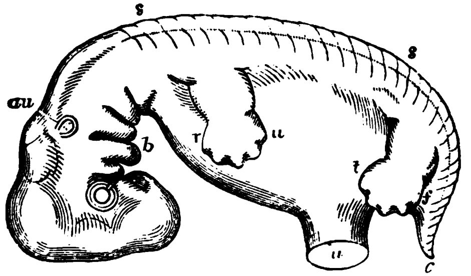


FIG. 16 —Diagrammatic outline of the human embryo when about seven weeks old, showing the relations of the limbs and tail to the trunk (after Allen Thomson). *r*, the radial, and *u*, the ulnar, border of the hand and fore-arm; *t*, the tibial, and *f*, the fibular, border of the foot and lower leg; *au*, ear; *s*, spinal cord; *v*, umbilical cord; *b*, branchial gill slits; *c*, tail.

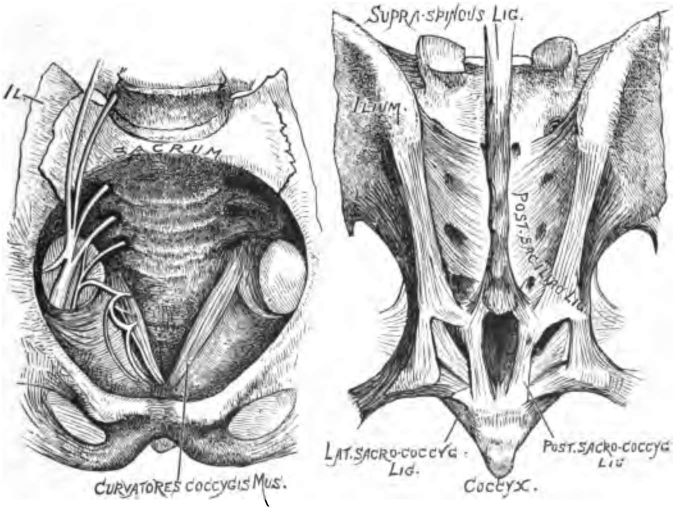


FIG 17.—Front and back view of adult human sacrum, showing abnormal persistence of vestigial tail-muscles. (The first drawing is copied from Prof. Watson's paper in *Journl. Anat. and Physiol.*, vol. 79: the second is compiled from different specimens).

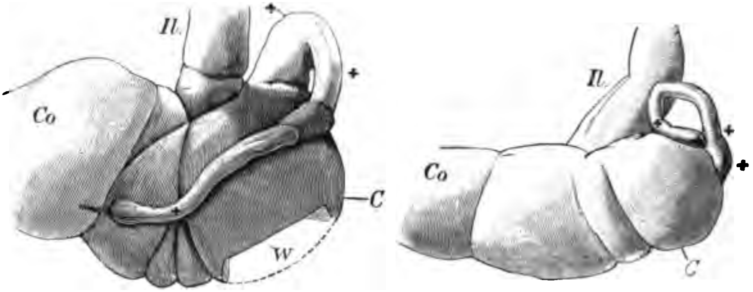


FIG. 18.—*Appendix vermiformis* in Orang and in Man. Drawn from dried inflated specimens in the Cambridge Museum by Mr. J. J. Lister. *Il*, ilium; *Co*, colon; *C*, cœcum; W, a window cut in the wall of the cœcum; x x x, the appendix.

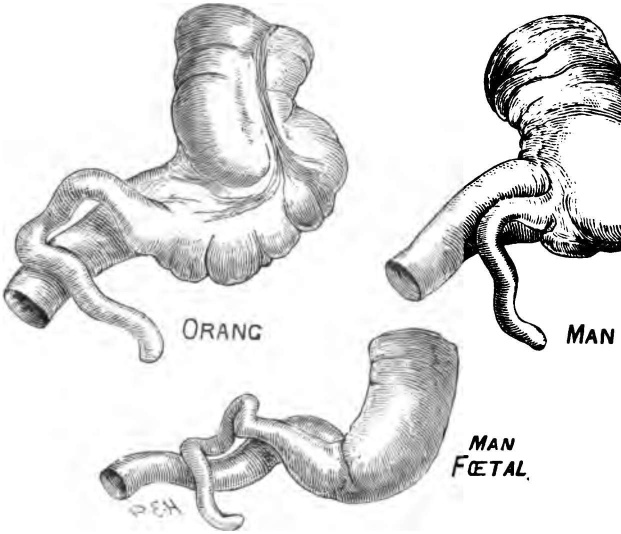


FIG. 19 —The same, showing variation in the Orang. Drawn from a specimen in the Museum of the Royal College of Surgeons.

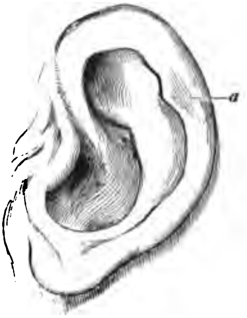


FIG. 20.—Human ear, modelled and drawn by Mr. Woolner. *a*, the projecting point.

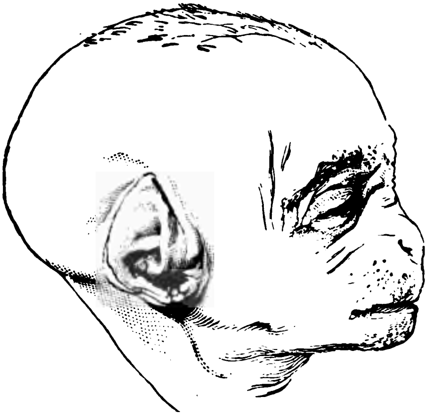


FIG. 21.—Fœtus of an Orang. Exact copy of a photograph, showing the form of the ear at this early stage.

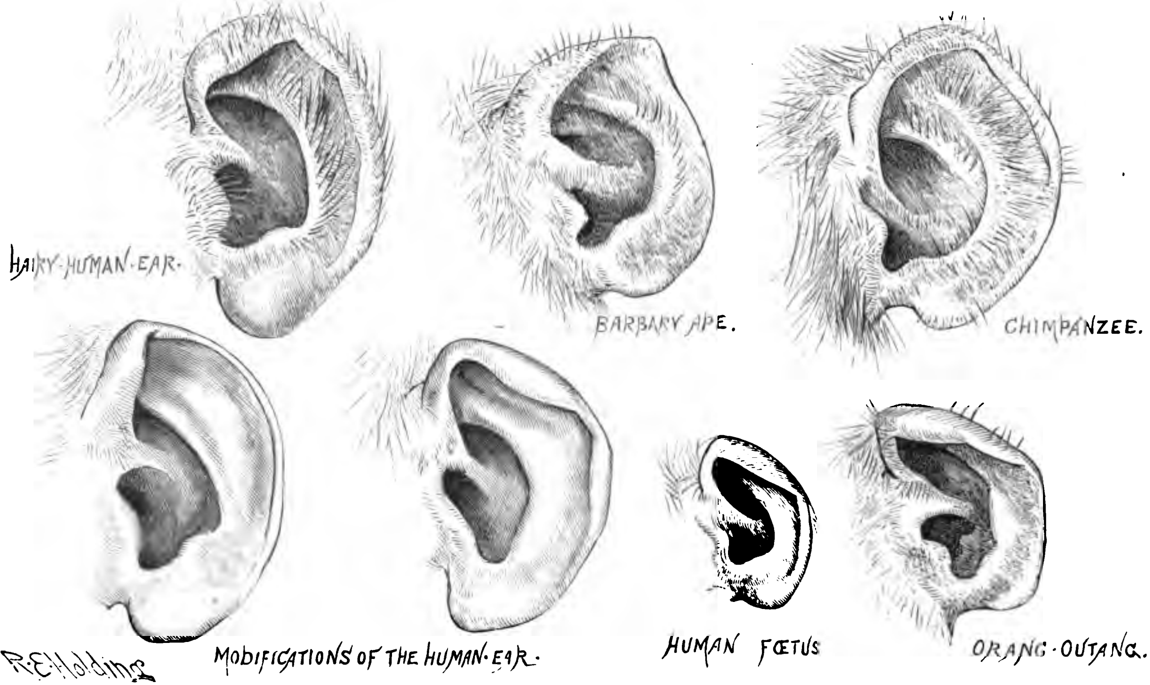


FIG. 22. - Vestigial characters of human ears. Drawn from nature.

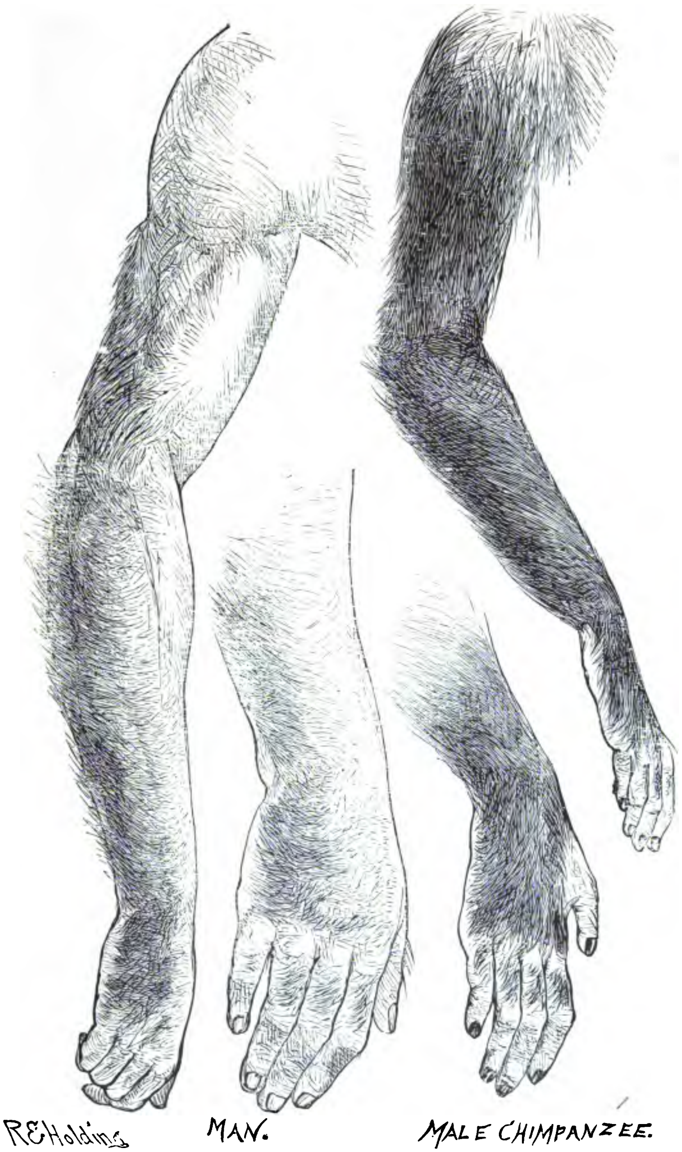


FIG. 23.—Hair-tracts on the arms and hands of Man, as compared with those on the arms and hands of Chimpanzee. Drawn from life.

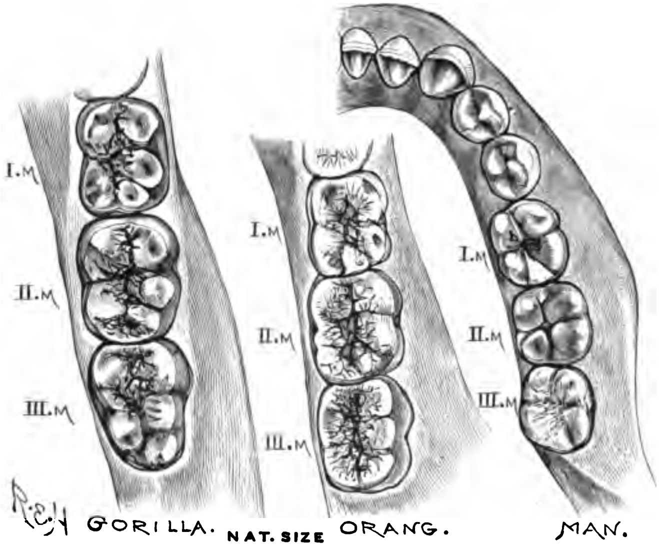


FIG. 24.—Molar teeth of lower jaw in Gorilla, Orang, and Man. Drawn from nature nat. size (*R. Mus. Coll. Surg.*)

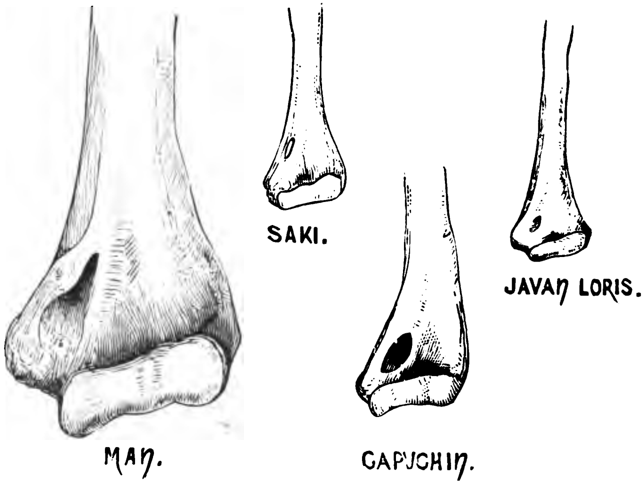


FIG. 25.—Perforation of the humerus (supra condyloid foramen) in three species of Quadrumana where it normally occurs, and in Man, where it does not normally occur. Drawn from nature (*R. Coll. Surg. Mus.*)

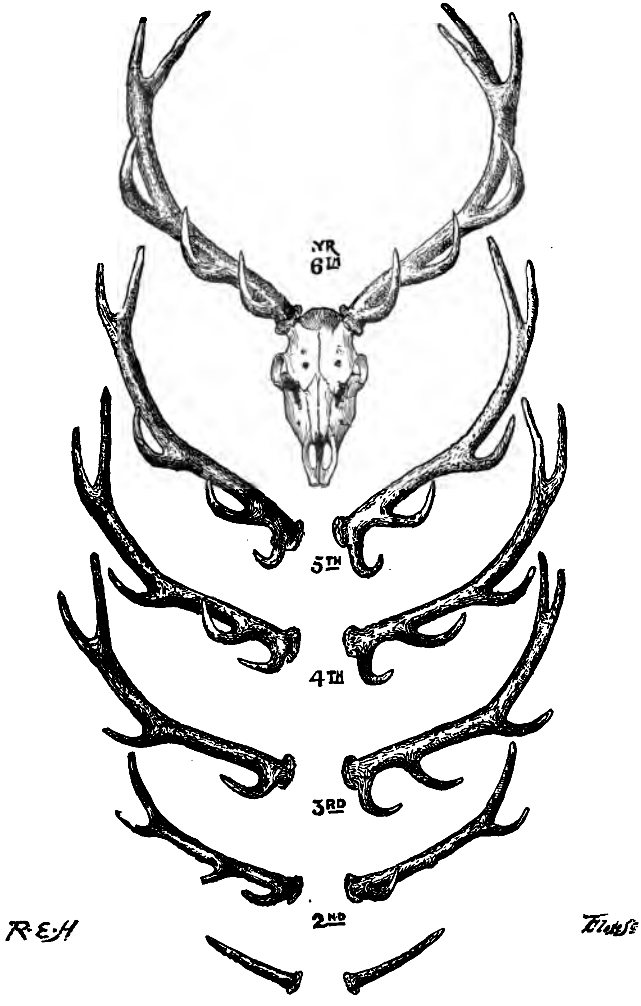


FIG. 26.—Antlers of Stag, showing successive addition of branches in successive years. Drawn from nature (*Brit. Mus.*)

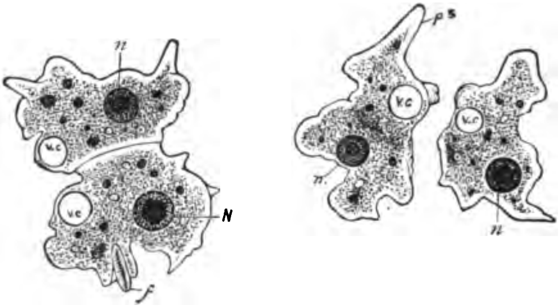


FIG. 27.— Fission of a Protozoön. In the left-hand drawing the process is represented as having advanced sufficiently far to have caused a division and segregation both of the nucleus and the vesicle. In the right hand drawing the process is represented as complete. *n*, N, severed nucleus; *vc*, severed vesicle; *ps*, pseudopodia; *f*, indigested food.

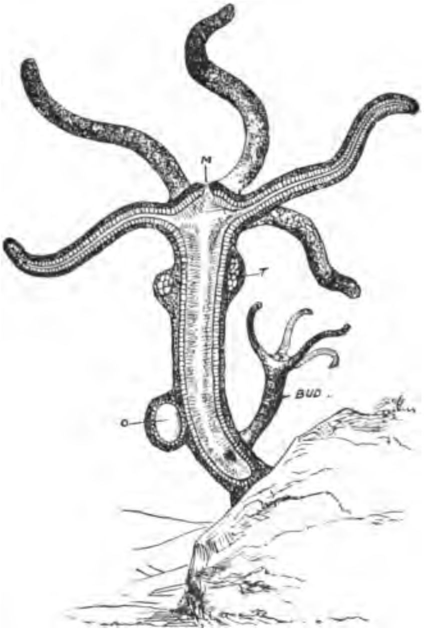


FIG. 28.—*Hydra viridis*, partly in section. M, mouth; O, ovary, or bud containing female reproductive cells; T, testis, or bud containing male reproductive cells. In addition to these buds containing germinal elements alone, there is another which illustrates the process of "gemmation"— i. e. the direct out-growth of a fully formed offspring.

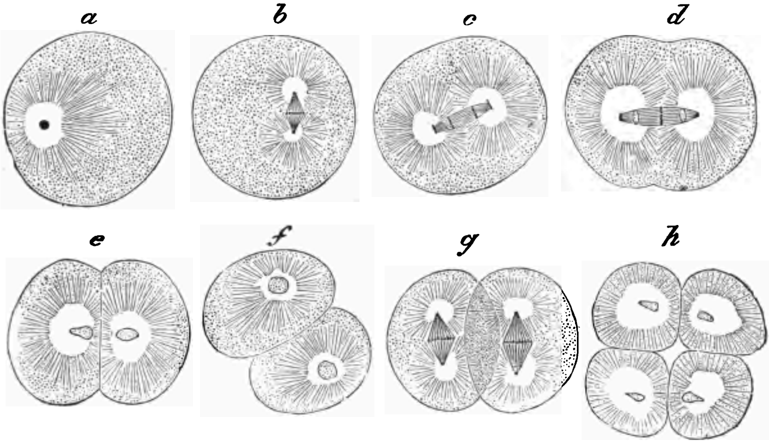


FIG. 29.—Successive stages in the division of the ovum, or egg cell, of a worm. (After Strasburger). *a* to *d* show the changes taking place in the nucleus and surrounding cell contents, which result in the first segmentation of the ovum at *e*: *f* and *g* show a repetition of these changes in each of the two resulting cells, leading to the second segmentation stage at *h*.

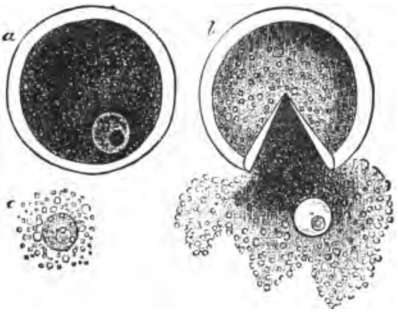


FIG. 30 —Ovarian ovum of a Mammal, (*a*) magnified and viewed under pressure, (*b*) burst by increased pressure, with yolk and nucleus escaping: (*c*) the nucleus more freed from yolk substance. (From *Quain's Anatomy*, after Allen Thomson).

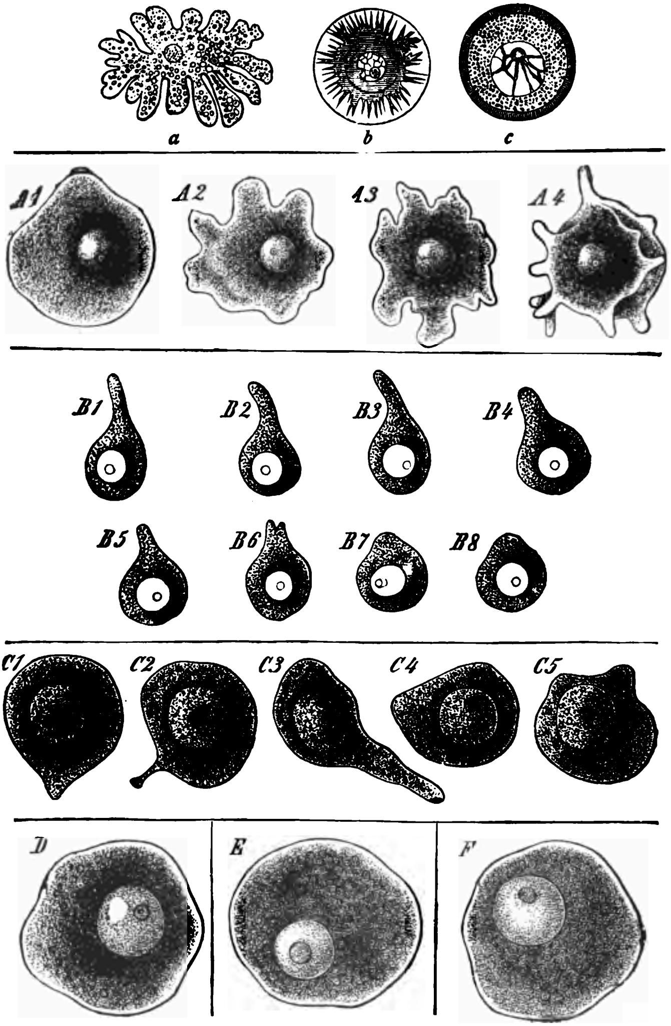


Fig. 31.—Amœboid movements of young egg-cells. *a*, Amœboid ovum of ***Hydra*** (from Balfour, after Kleinenberg); *b*, early ovum of ***Toxopneustes variegatus***, with pseudopodia-like processes (from Balfour, after Selenka); *c*, ovum of ***Toxopneustes lividus***, more nearly ripe (from Balfour, Hertwig). A1 to A4, the primitive egg-cell of a Chalk sponge (***Leuculmis echinus***), in four successive conditions of motion. B1 to B8, ditto of a Hermit-Crab (***Chondracanthus cornutus***), in eight successive stages (after E. von Beneden). C1 to C5, ditto of a Cat, in five successive stages (after Pfluger). D, ditto of Trout; E, of a Hen; F, of Man. The first series is taken from the ***Encycl. Brit.***; the second from Häckel's ***Evolution of Man.***

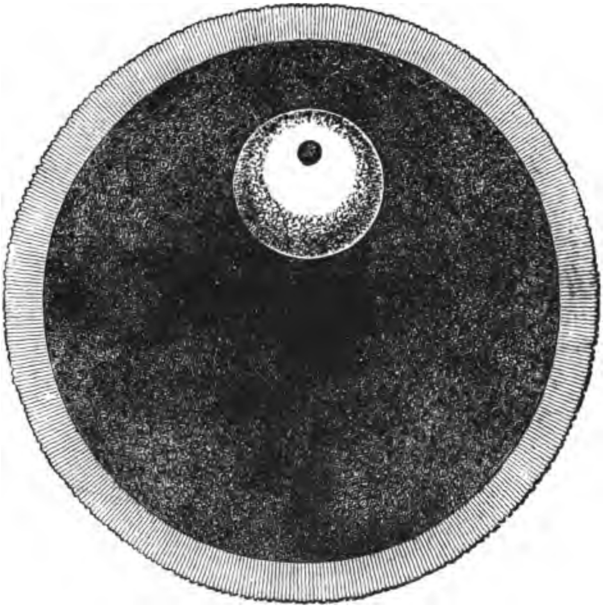


FIG. 32.—Human ovum, mature and greatly magnified. (After Häckel).

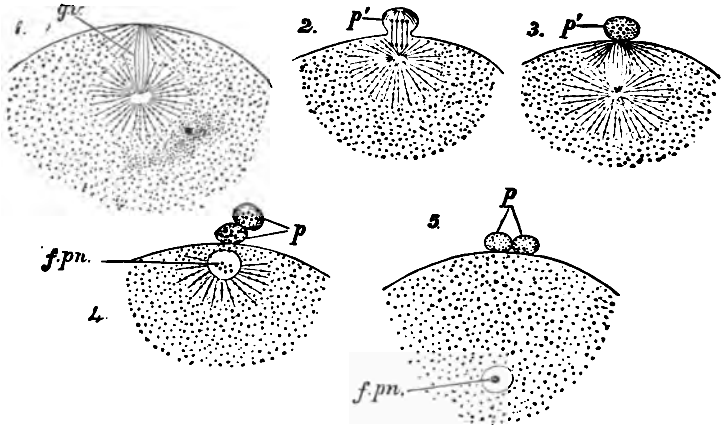


FIG. 33.—Stages in the formation of the polar bodies in the ovum of a star fish. (After Hertwig). *g v*, germinal vesicle transformed into a spindle-shaped system of fibres; *pl*, the first polar body becoming extruded; *p.,p.*, both polar bodies fully extruded; *f pn.*, female pronucleus, or residue of the germinal vesicle.

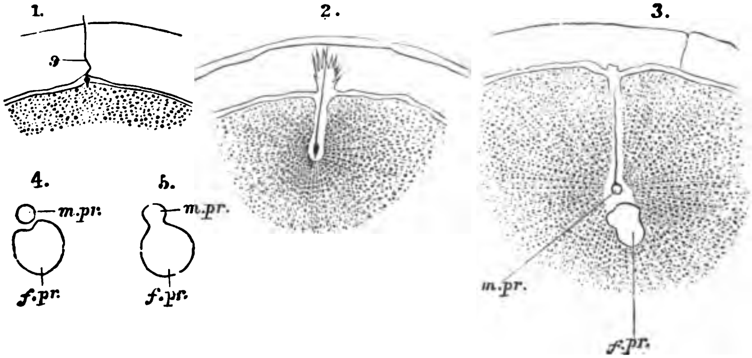


FIG. 34.—Fertilization of the ovum of an echinoderm. (From *Quain's Anatomy*, after Selenka). S, spermatozoön; *m pr.*, male pronucleus; *f p.*, female pronucleus. 1 to 4 correspond to D to G in the next figure.

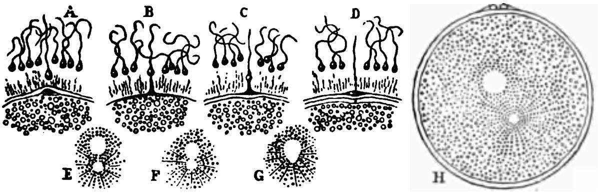


FIG. 35.—Fertilization of the ovum of a star-fish. (From the *Encycl. Brit.* after Fol.) A, spermatozoa in the mucilaginous coat of the ovum; a prominence is rising from the surface of the ovum towards a spermatozoön; B, they have almost met; C, they have met; D, the spermatozoön enters the ovum through a distinct opening; H, the entire ovum, showing extruded polar bodies on its upper surface, and the moving together of the male and female pronuclei; E, F, G, meeting and coalescence of the pronuclei.

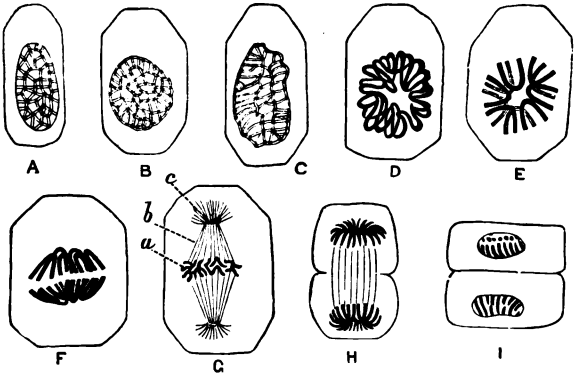


FIG. 36.—Karyokinesis of a typical tissue-cell (epithelium of Salamander). (After Flemming and Klein). The series from A to I represents the successive stages in the movement of the chromatin fibres during division, excepting G which represents the "nucleus-spindle" of an egg-cell. A, resting nucleus; D, wreath-form; E, single star, the loops of the wreath being broken; separation of the star into two groups of U-shaped fibres; H, diaster or double star; I, completion of the cell-division and formation of two resting nuclei. In G the chromatin fibres are marked *a*, and correspond to the "equatorial plate"; *b*, achromatin fibres forming the nucleus spindle; *c*, granules of the cell-protoplasm forming a ‘polar star." Such a polar star is seen at each end of the nucleus spindle, and is not to be confused wiih the diaster H, the two ends of which are composed of *chromatin*.

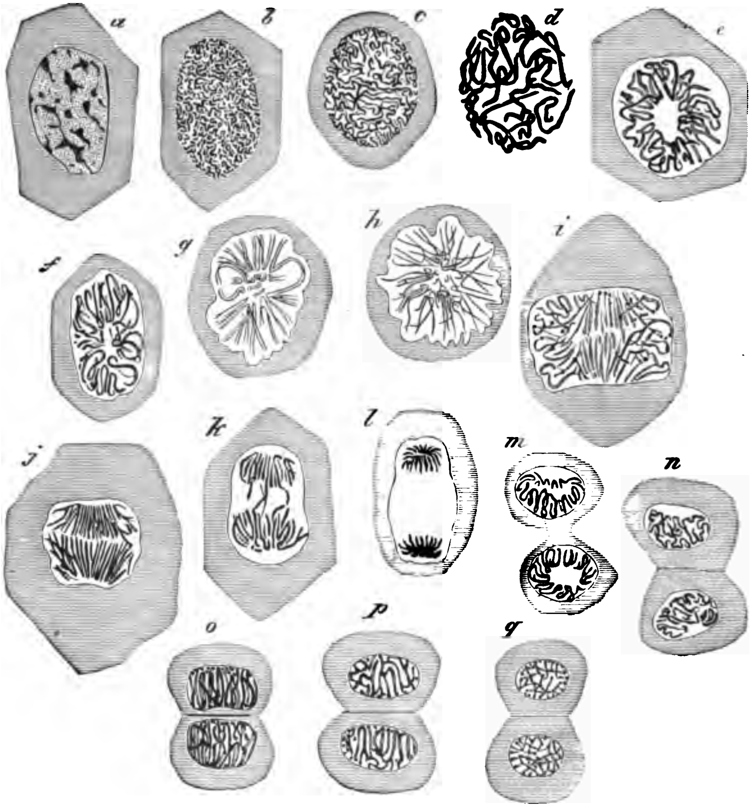


FIG. 37.—Study of successive changes taking place in the nucleus of an epithelium-cell, preparatory to division of the cell. (From *Quain's Anatomy*, after Flemming). *a*, resting cell, showing the nuclear network; *b*, first stage of division, the chromatoplasm transformed into a skein of closely contorted filaments; *c* to *f*, further stages in the growth and looping arrangement of the filaments; *g*, stellate phase, or aster; *h*, completion of the splitting of the filaments, already begun in *f* and *g*; *i*, *j*, *k*, successive stages in separation of the filaments into two groups; *l*, the final result of this (diaster); *m* to *q*, stages in the division of the whole cell into two, showing increasing contortion of the filaments, until they reach the resting stage at *q*.

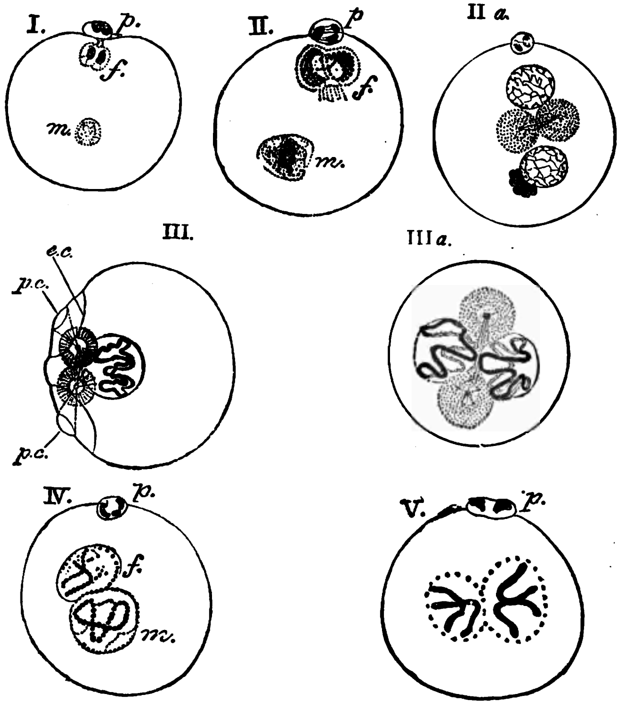


FIG. 38.—Formation and conjugation of the pronuclei in *Ascaris megalocephala*. (From *Quain's Anatomy*, after E. von Beneden). *f*, female pronucleus; *m*, male pronucleus; *p*, one of the polar bodies.

I. The second polar body has just been extruded; both male and female pronuclei contain two chromatin particles; those of the male pronucleus are becoming transformed into a skein.

II. The chromatin in both pronuclei now forms into a skein.

II*a*. The skeins are more distinct. Two attraction (or protoplasmic) spheres, each with a central particle united with a small spindle of achromatic fibres, have made their appearance in the general substance of the egg close to the mutually approaching pronuclei. The male pronucleus has the remains of the body of the spermatozoon adhering to it.

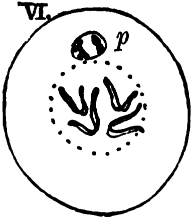
III. Only the female pronucleus is shown in this figure. The skein is contracted and thickened. The attraction spheres are near one side of the ovum, and are connected with its periphery by a cone of fibres forming a polar circle, *p.c.*; *e.c.*, equatorial circle.

III*a*. The pronuclei have come into contact, and the spindle-system is now arranged across their common axis.

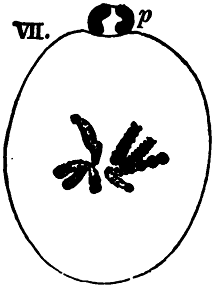
IV. Contraction of the skein, and formation of two U or V-shaped chromatin fibres in each pronucleus.

V. The V-shaped chromatin filaments are now quite distinct: the male and female pronuclei are in close contact.

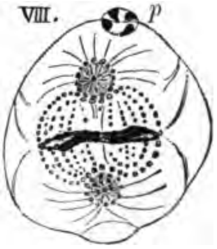
VI.



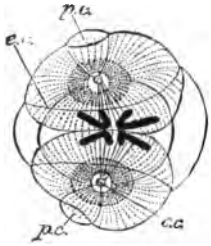
VII.



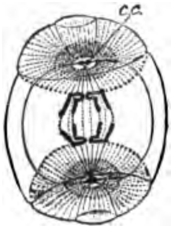
VIII.



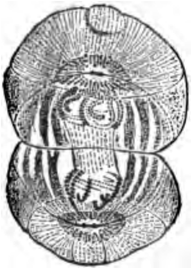
IX.



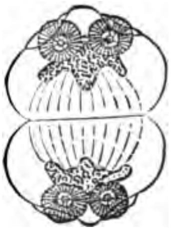
X.



XI.



XII.



VI., VII. The V-shaped filaments are splitting longitudinally; their structure of fine granules of chromatin is apparent in VII., which is more highly magnified. The conjugation of the pronuclei is apparently complete in VII. The attraction-spheres and achromatic spindle, although present, are not depicted in IV., V., VI., and VII.

VIII. Equatorial arrangement of the four chromatin loops in the middle of the now segmenting ovum: the achromatic substance forming a spindle-shaped system of granules with fibres radiating from the poles of the spindle (attraction-spheres); the chromatin forms an equatorial plate. (Compare Fig. 36 G.)

IX. Shows diagrammatically the commencing separation of the chromatin fibres of the conjugated nuclei, and the system of fibres radiating from the attraction spheres. (Compare again Fig. 36 G.) ***p.c.***, polar circle; ***e.c.***, equatorial circle; ***c.e.***, central particle.

X. Further separation of the chromatin filaments. Each of the central particles of the attraction-spheres has divided into two.

XI. The chromatin fibres are becoming developed into the skeins of the two daughter-nuclei. These are still united by fibres of achromatin. The general protoplasm of the ovum is becoming divided.

XII. The two daughter-nuclei exhibit a chromatin network. Each of the attraction-spheres has divided into two, which are joined by fibres of achromatin, and connected with the periphery of the cell in the same way as in the original or parent sphere, III.

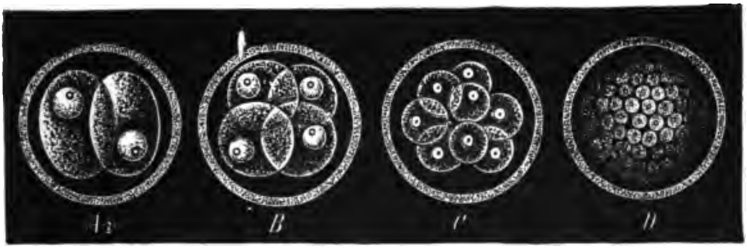


FIG. 39.—Segmentation of ovum. (After Häckel.) Successive stages are marked by the letters A, B, C. D represents several stages in advance of C.

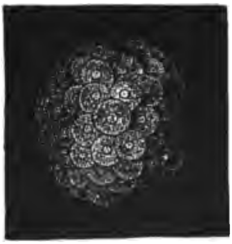


FIG. 40—The contents of an ovum in an advanced stage of segmentation, drawn in perspective. (After Häckel).

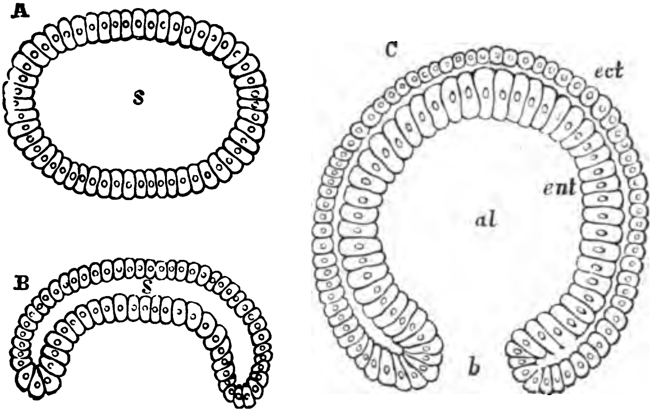


FIG 41.—Formation of the gastrula of *Amphioxus*. (After Kowalevsky). A, wall of the ovum, composed of a single layer of cells; B, a stage in the process of gastrulation; C, completion of the process; S, original or segmentation cavity of ovum; *al*, alimentary cavity of gastrula; *ect*, outer layer of cells; *ent*, inner layer of cells; *b*, orifice, constituting the mouth in permanent forms.

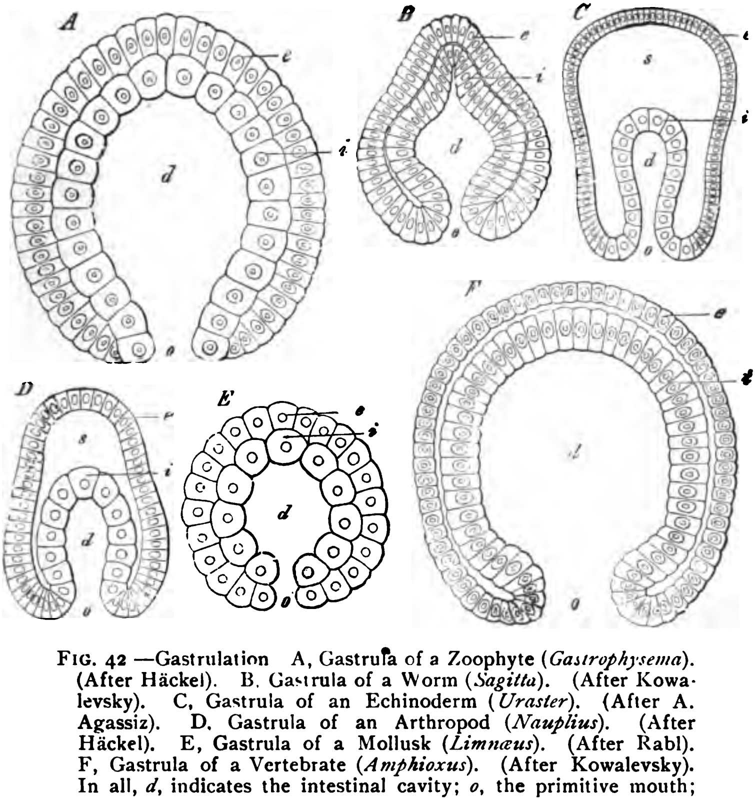


FIG. 42 —Gastrulation A, Gastrula of a Zoophyte (*Gastrophysema*). (After Häckel). B. Gastrula of a Worm (*Sagitta*). (After Kowalevsky). C, Gastrula of an Echinoderm (*Uraster*). (After A. Agassiz). D. Gastrula of an Arthropod (*Nauplius*). (After Häckel). E, Gastrula of a Mollusk (*Limnæus*). (After Rabl). F, Gastrula of a Vertebrate (*Amphioxus*). (After Kowalevsky). In all, *d*, indicates the intestinal cavity; *o*, the primitive mouth; *s*, the cleavage cavity; *i*, the endoderm, or intestinal layer; *e*, the ectoderm or skin-layer.

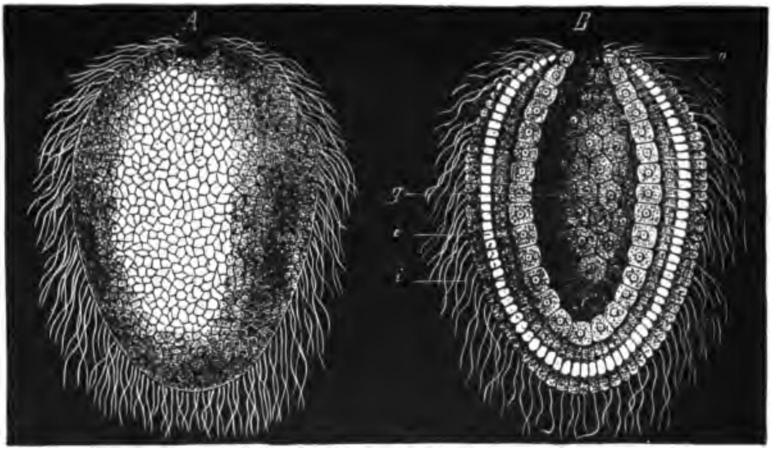


FIG. 43.—Gastrula of a Chalk Sponge. (After Häckel). A, External view. B, Longitudinal section. *g*, digestive cavities; *o*, mouth; *i*, endoderm; *e*, ectoderm.

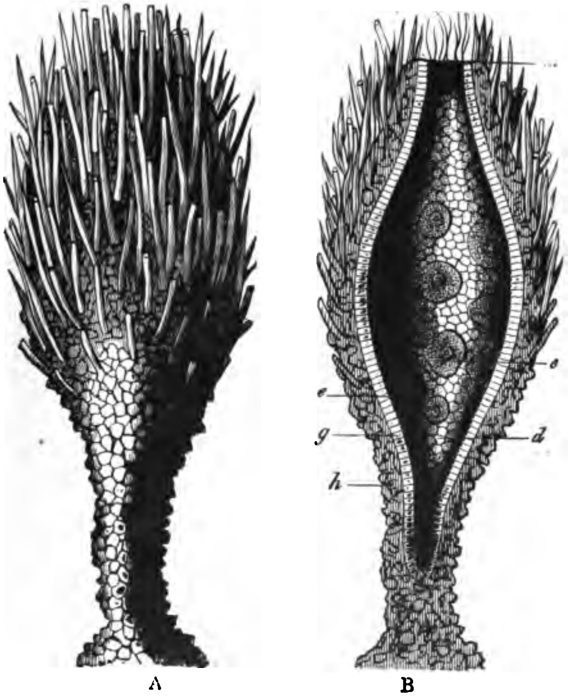


Fig. 44.—*Prophysema primordiale*, an extant gastræa form. (After Häckel) (A). External view of the whole animal, attached by its foot to seaweed. (B.) Longitudinal section of the same. The digestive cavity (*d*) opens at its upper end in the mouth (*m*). Among the cells of the endoderm (*g*) lie amœboid egg-cells of large size (*e*). The ectoderm (*h*) is encrusted with grains of sand, above the sponge spicules.

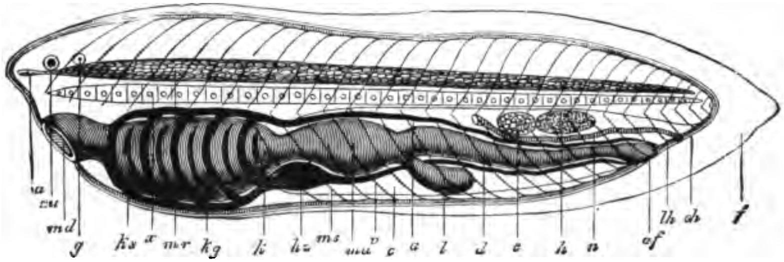


FIG 45.—Ideal primitive vertebrate, seen from the left side. (After Häckel). *na*, nose; *au*, eye; *g*, ear; *md*, mouth; *ks*, gill openings; *x*, notochord; *mr*, spinal tube; *kg*, gill-vessels; *k*, gill-intestine; *hz*, heart; *ms*, muscles; *ma*, stomach; *v*, intestinal vein; *c*, body-cavity; *a*, aorta; *l*, liver; *d*, small intestine; *e*, ovary; *h*, testes; *n*, kidney-canal; *af*, anus; *lh*, true or leather-skin; *oh*, outer-skin; (epidermis); *f*, skin-fold, acting as a fin.

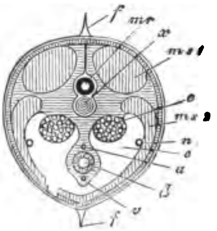


FIG. 46.—The same in traverse section through the ovaries; lettering as in the preceding Fig.

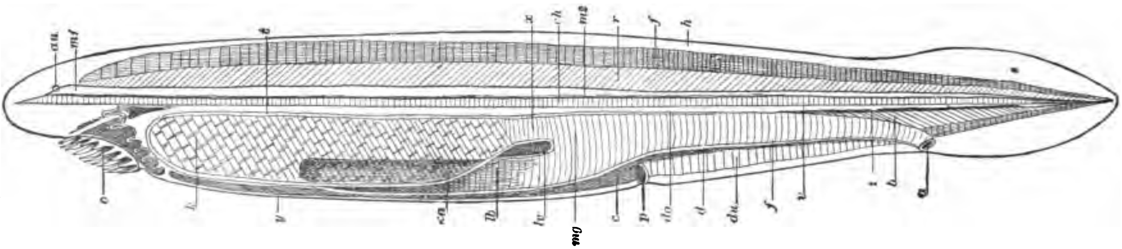


FIG. 47.——*Amphioxus lanceolatus*. (After Häckel). *a*, anus; *au*, eye; *b*, ventral muscles; *c*, body-cavity; *ch*, notochord; *d*, intestine; *do* and *du*, dorsal and ventral walls of intestine; *f*, fin-seam; *h*, skin; *k*, gills; *ka*, gill-artery; *lb*, liver; *lv*, liver-vein; *m* 1, brain-bladder; *m* 2, spinal marrow; *mg*, stomach; *o*, mouth; *p*, ventral pore; *r*, dorsal muscle; *s*, tail-fin; *t*, aorta; *v*, intestinal vein; *x*, boundary between gill-intestine and stomach-intestine; *y*, hypobranchial groove.

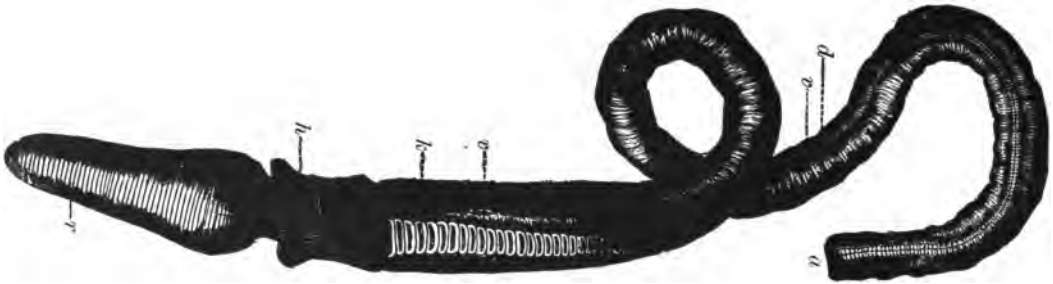


FIG. 48 —*Balanoglossus.* (After A. Agassiz.) *r*, proboscis; *h*, collar; *k*, gill-slits; *d*, digestive posterior intestine; *v*, intestinal vessel; *a*, anus.

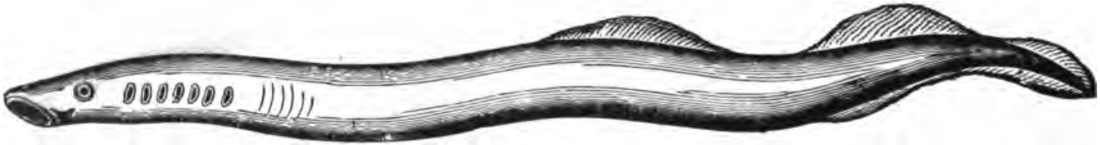


FIG. 49.—A large Sea-lamprey (*Petromyzon marinus*), much reduced in size. (After Cuvier and Häckel). A series of seven gill-slits are visible.

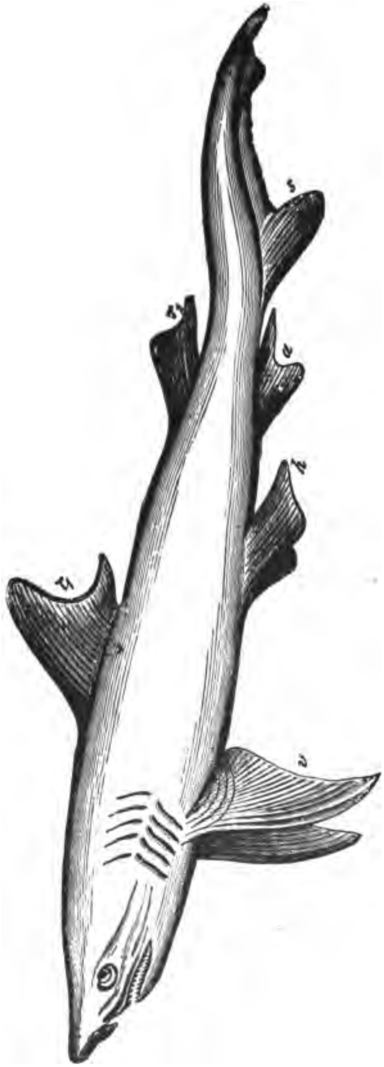


Fig. 50.—Adult Shark (*Carcharias melanopterus*). (After Cuvier and Häckel).

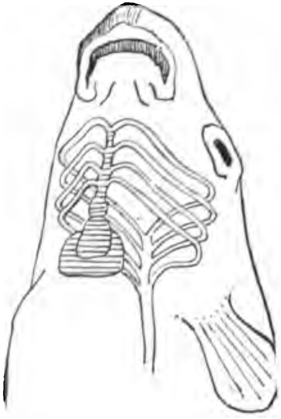


FIG. 51.—Diagram of heart and gill-arches of a fish. (After Owen.)

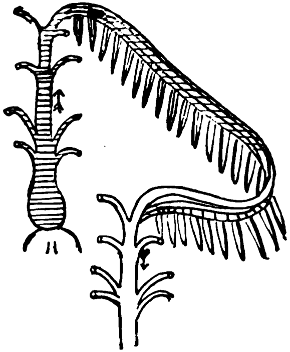


FIG. 52.—One gill-arch, with branchial fringe attached. (After Owen.) H, Heart.

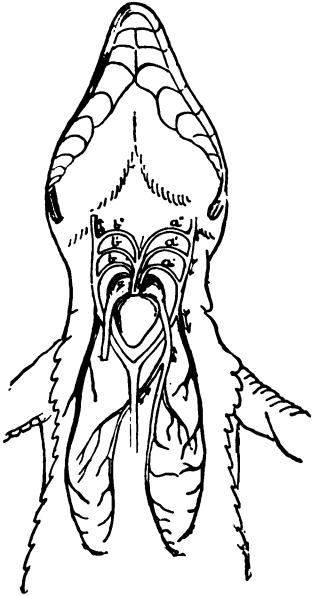


FIG. 53.—Diagram of heart and gill-arches in a lizard. (After Owen) The gill-arches, *a a' a''*, and *b b' b''*, are called aortic arches in air-breathing vertebrata.

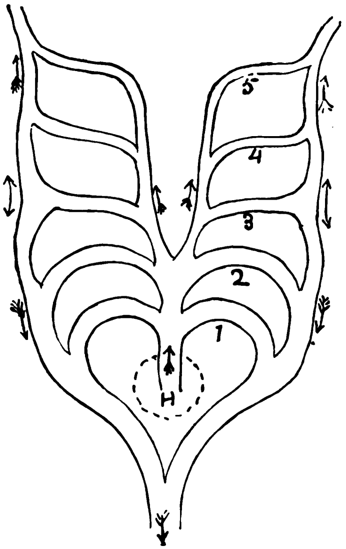


FIG. 54.—Ideal diagram, of primitive gill or aortic arches. (After Rathke). H, outline of heart. The arrows show the course of the blood.

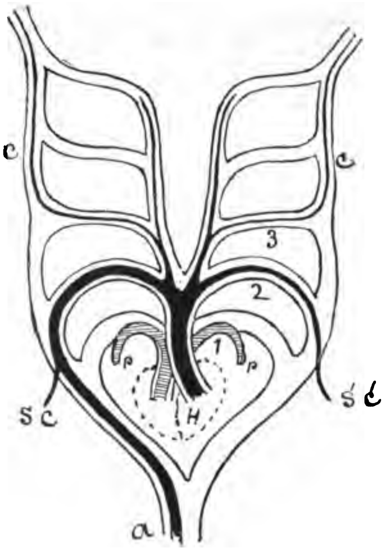


FIG. 55.—The same, modified for a bird. (After Le Conte). The dark lines show the aortic arches which persist. A, aorta; p. pulmonary arches; SC, S'C', sub-clavian; C, C', carotids.

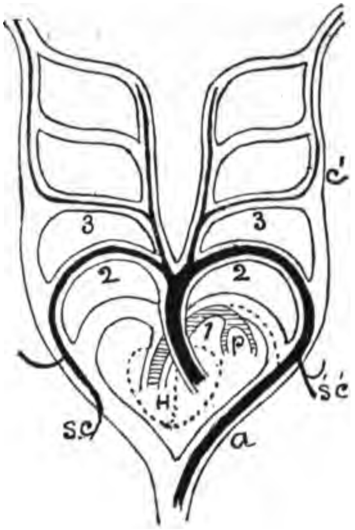


FIG. 56.— The same, modified for a mammal. (After Le Conte).

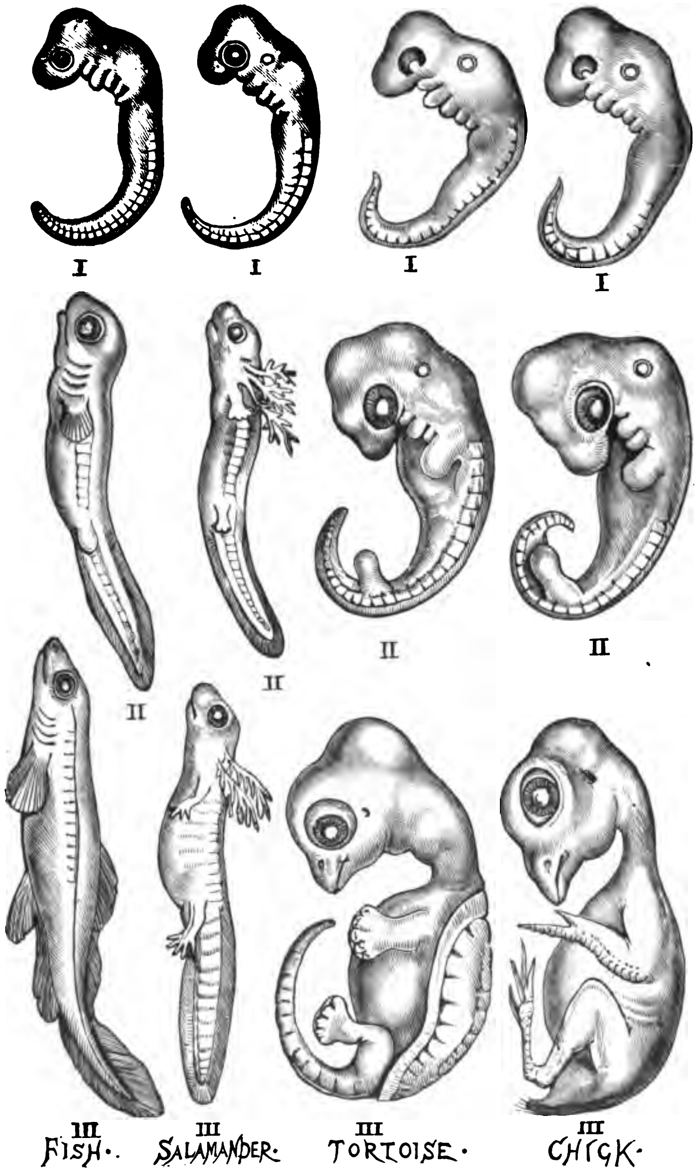


FIG. 57.—A series of embryos at three comparable and progressive stages of development (marked I, II, III), representing each of the classes of vertebrated animals below the Mammalia. (After Häckel.)

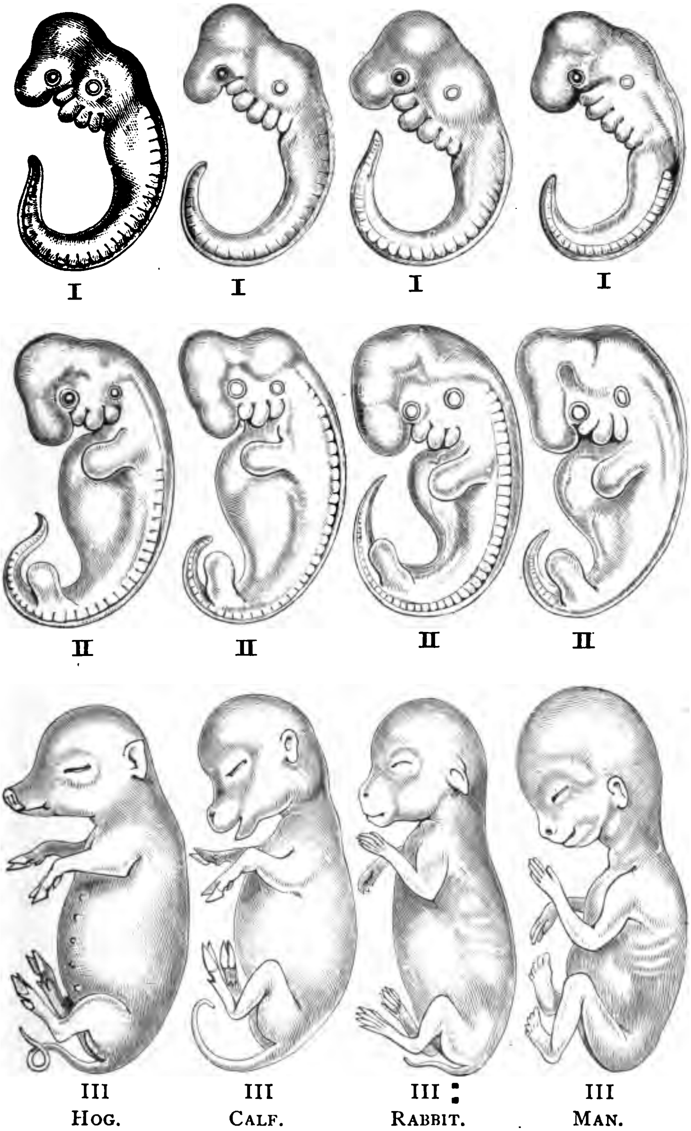


Fig. 58.—Another series of embryos, also at three comparable and progressive stages of development (marked I, II, III), representing four different divisions of the class Mammalia. (After Häckel).

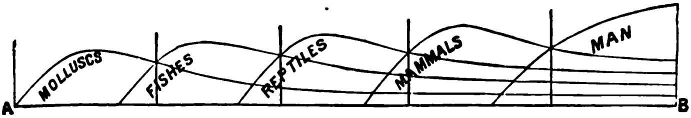


FIG. 59.—Diagram of Geological Succession of the Classes of the Animal Kingdom. (After Le Conte).

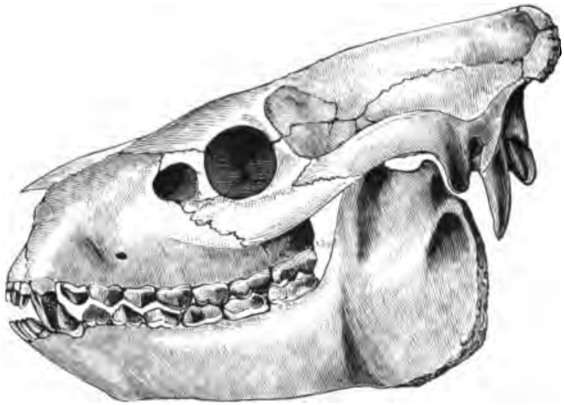


FIG. 60.—Skull of *Oreodon Culbertsoni.* (After Leidy).

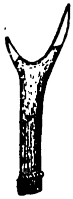


FIG. 61.

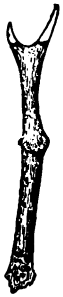


FIG. 62.

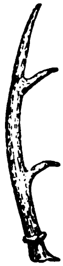


FIG. 63.

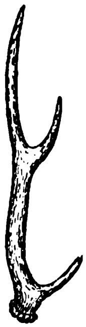


FIG. 64.

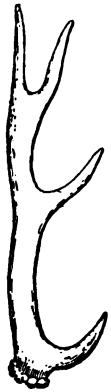


FIG. 65.

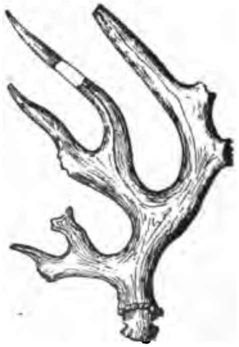


FIG. 66.

The series is reduced from Gaudry's illustrations, after Farge, Croizet, Jobert and Boyd Dawkins.

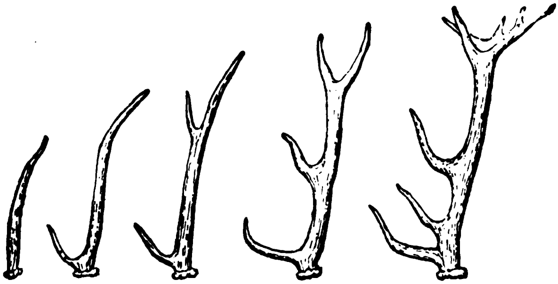


FIG. 67.—Successive stages in the development of an existing Deer's Antlers. (After Gaudry, but a better illustration has already been given on p. 100.)

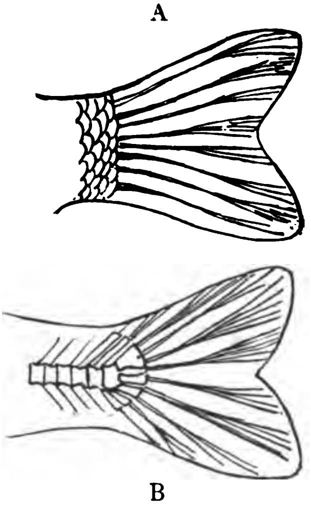


FIG. 68.—Homocercal Tail, showing (A) external form and (B) internal structure.

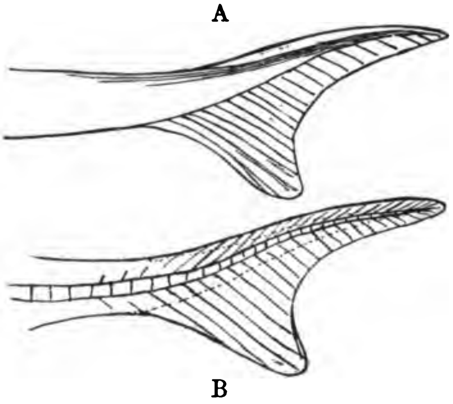


Fig. 69.—Heterocercal Tail, showing (A) external form and (B) internal structure.

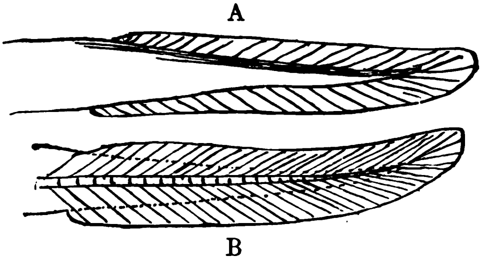


Fig 70.—Vertebrated but symmetrical fin (diphycercal), showing (A) external form and (B) internal structure.

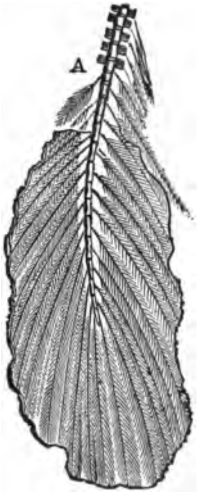


FIG. 71.—Tail of *Archæopteryx*. A indicates origin of simply-jointed tail.

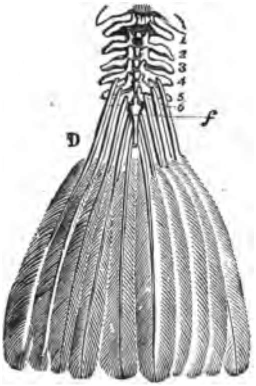


FIG. 72.—Tail of modern Bird The numerals indicate the foreshortened, enlarged, and consolidated joints; *f*, terminal segment of the vertebral column; D, shafts of feathers.

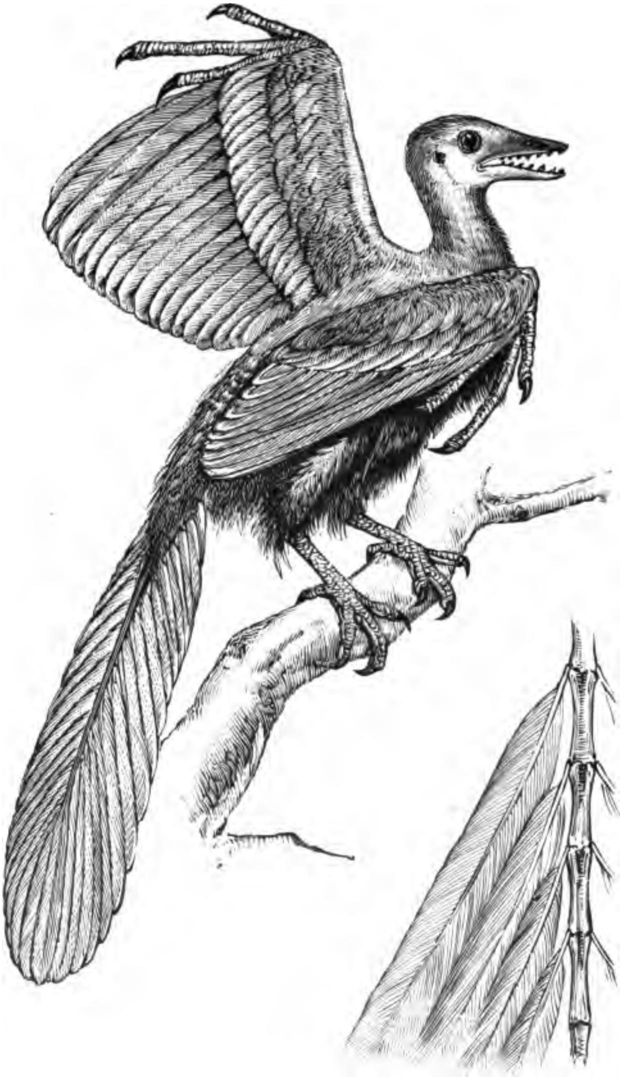


FIG. 73.—*Archæopteryx macura,* restored, ⅛ nat. size. (After Flower). The section of the tail is copied from Owen, nat. size.

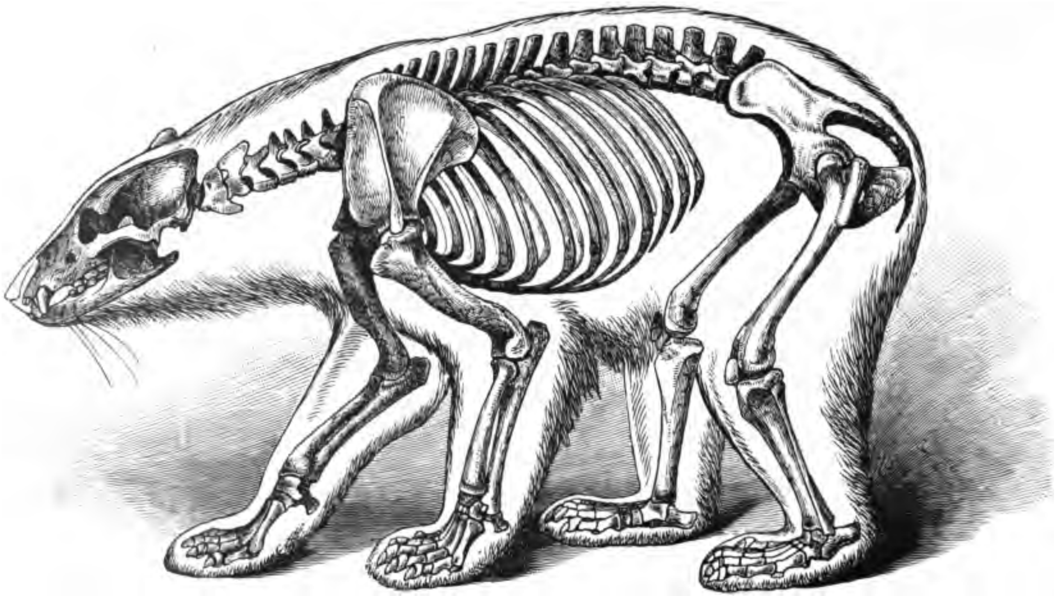


FIG. 74.—Skeleton of Polar Bear, drawn from nature (*Brit. Mus.*)

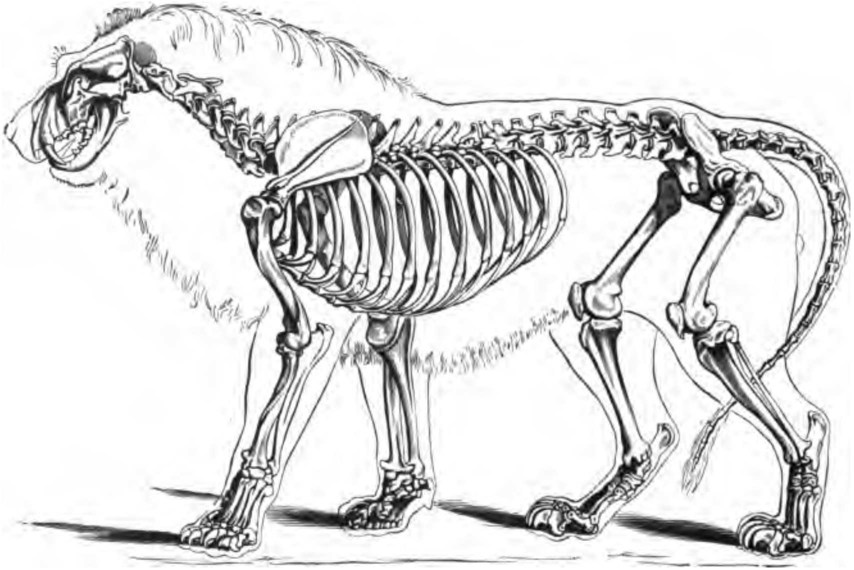


FIG. 75.—Skeleton of Lion. (After Huxley).

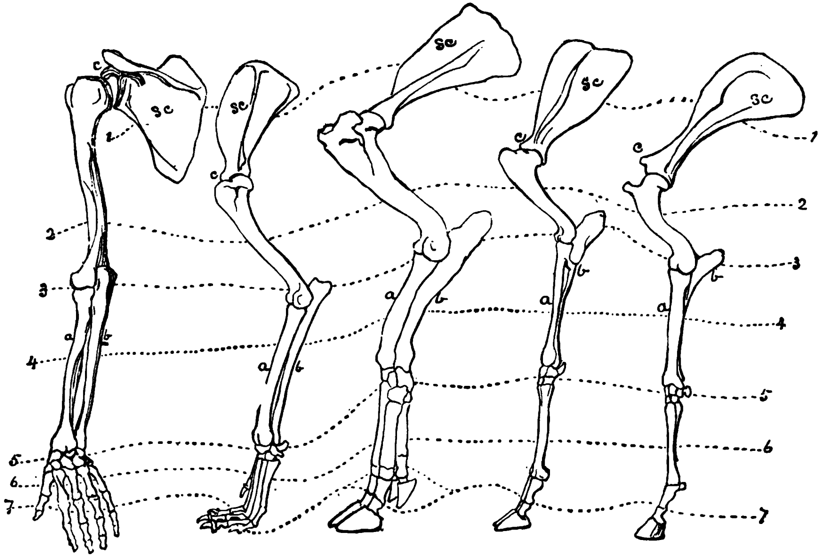


FIG. 76.—Anterior limb of Man, Dog, Hog, Sheep, and Horse. (After Le Conte). *Sc*, shoulder-blade; *c*, coracoid; *a*, *b*, bones of fore-arm; 5, bones of the wrist; 6, bones of the hand; 7, bones of the fingers.

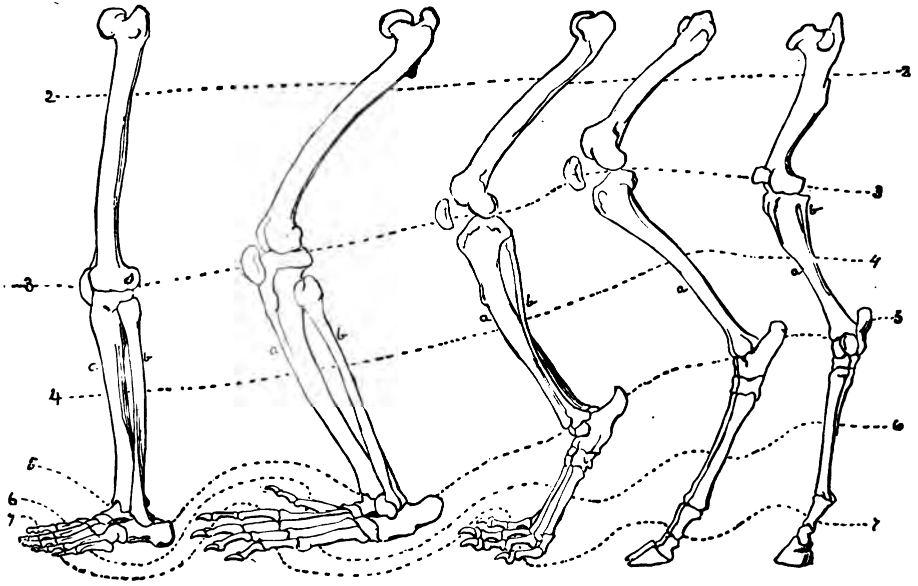


FIG. 77.—Posterior limb of Man, Monkey, Dog, Sheep, and Horse. (After Le Conte.) 1, Hip-joint; 2, thigh-bone; 3, knee-joint; 4, bones of leg; 5, ankle-joint; 6, bones of foot; 7, bones of toes.

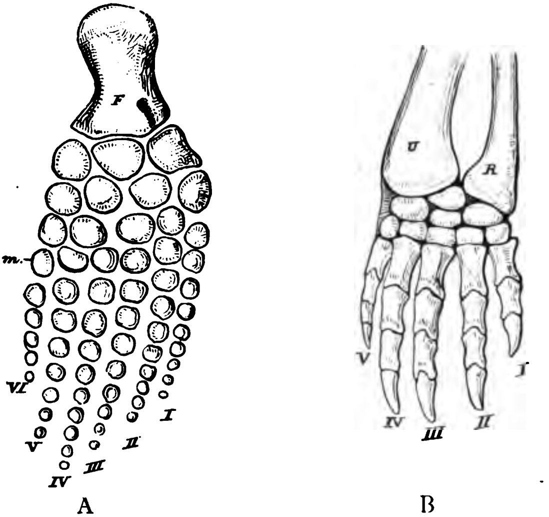


FIG. 78.—A, posterior limb of *Babtanodon discus.* (After Marsh). F, **thigh-bone**; I to VI, undifferentiated bones of the leg and foot. B, anterior limb of *Chelydra serpentina.* (After Gegenbaur). U and R, bones of the fore-arm; I to V, fully differentiated bones of the hand, following those of the wrist.

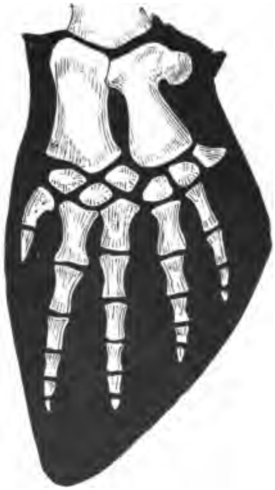


FIG. 79.—Paddle of a Whale.

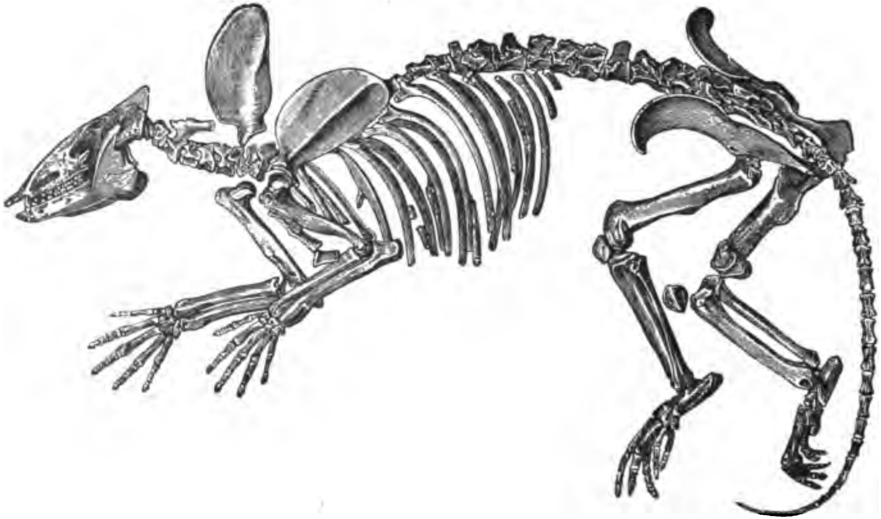
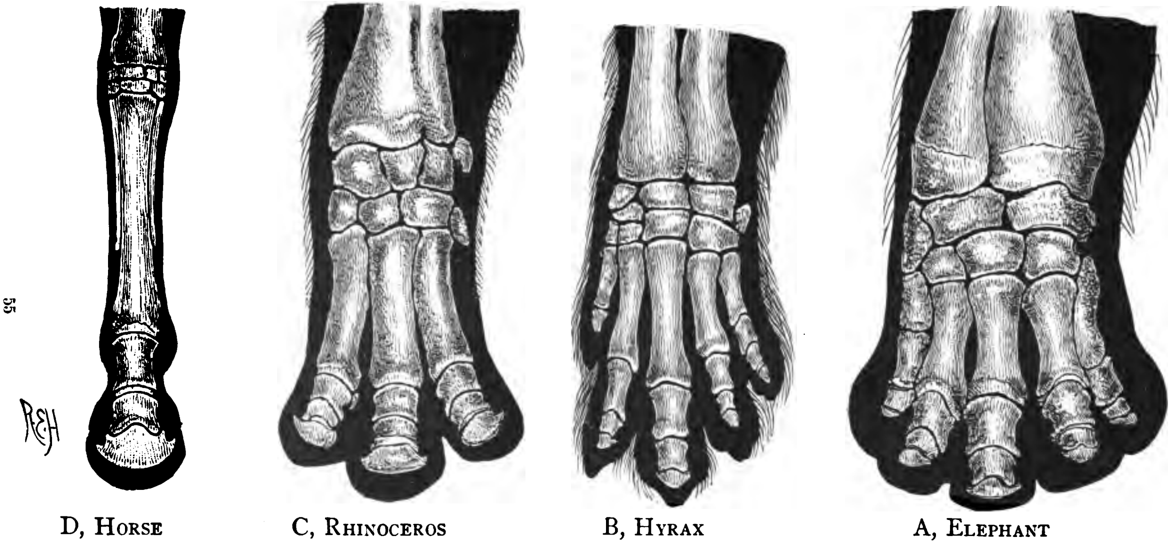
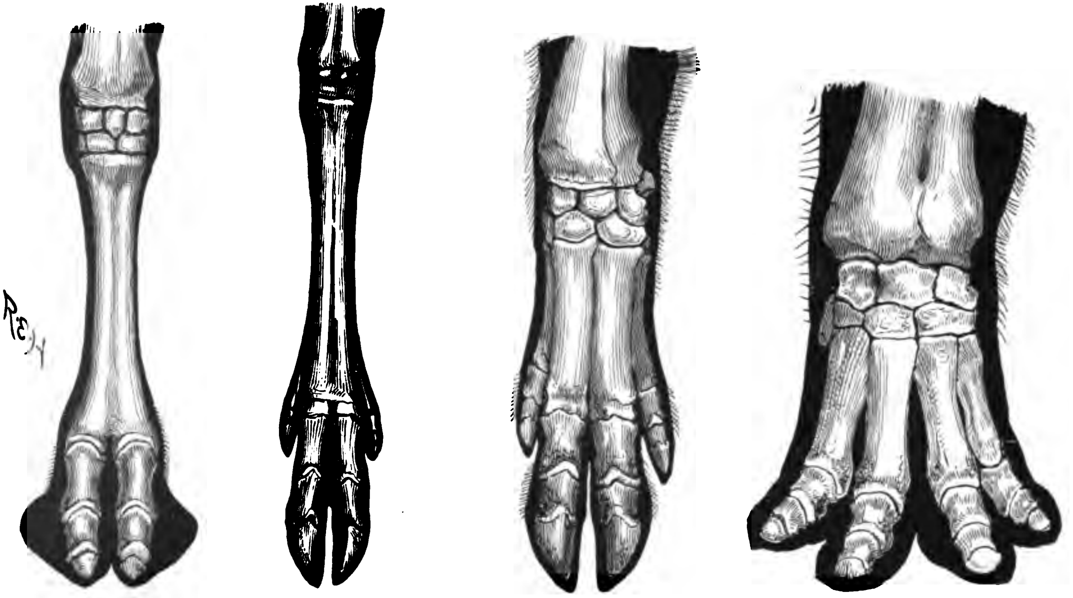


Fig. 80.—Fossil skeleton of *Phenacodus primævus*. (After Cope.)



D, HORSE C, RHINOCEROS B, HYRAX A, ELEPHANT

FIG. 81.—Bones of the foot of four different forms of the perissodactyl type, showing gradual reduction in the number of digits, coupled with a greater consolidation of the bones above the digits. The series reads from right to left. Drawn from nature (*Brit. Mus.*)



D, CAMEL C, DEER B, PIG A, HIPPOPOTAMUS

FIG. 82.—Bones of the foot of four different forms of the artiodactyl type, showing gradual reduction of the number of digits, coupled with a greater consolidation of the bones above the digits. The series reads from right to left. Drawn from nature (*Brit. Mus.*)

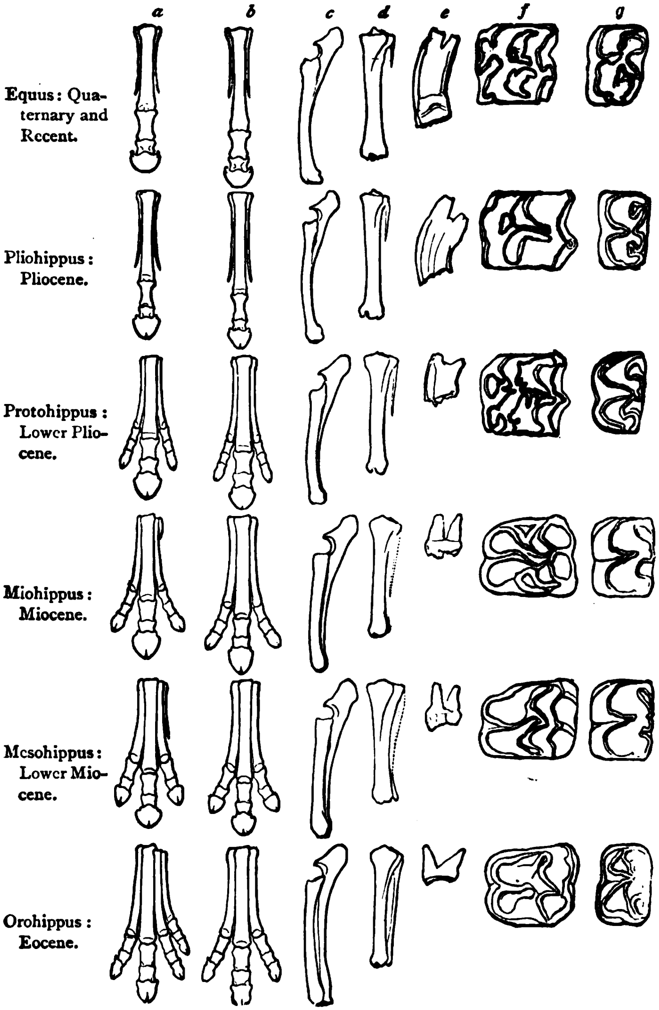

a
b
c
d
e
f
g
Equus: Quaternary and Recent.
Pliohippus: Pliocene.
Protohippus: Lower Pliocene.
Miohippus: Miocene.
Mesohippus: Lower Miocene.
Orohippus: Eocene.

FIG 83.—Feet and teeth in fossil pedigree of the Horse. (After Marsh). *a*, bones of the fore-foot; *b*, bones of the hind-foot; *c*, radius and ulna; *d*, tibia and fibula; *e*, roots of a tooth; *f* and *g*, crowns of upper and lower molar teeth.

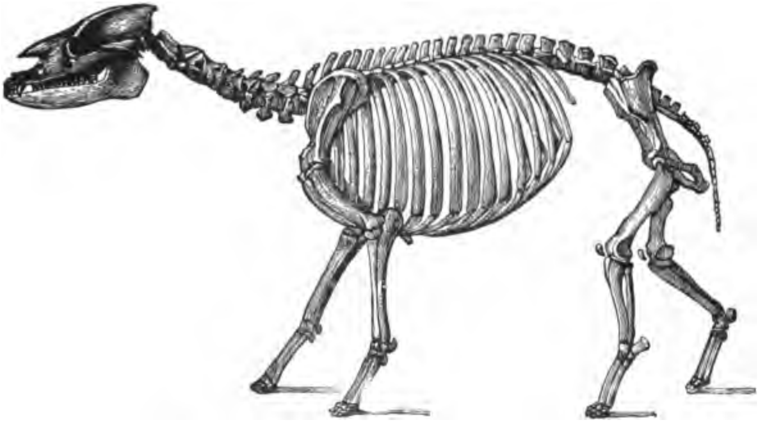


FIG. 84 —*Palæotherium*. (Lower Tertiary of Paris Basin)

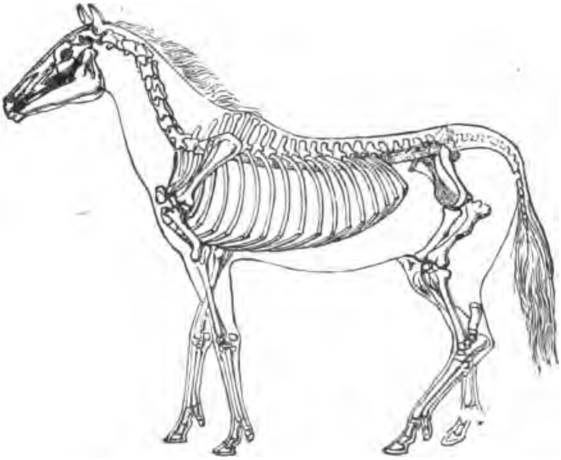


FIG. 85.—*Hipparion*. (New World Pliocene).

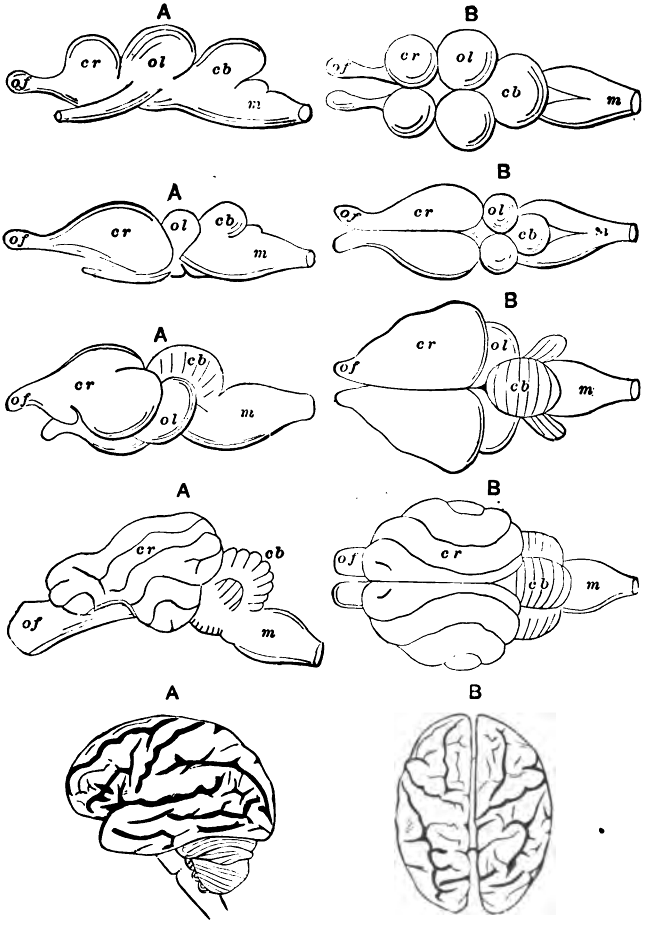


FIG. 86.—Comparative series of Brains. (After LeConte). The series reads from above downwards, and represents diagrammatically the brain of a Fish, a Reptile, a Bird, a Mammal, and a Man. In each case the letter A marks a side view, and the letter B a top view. The small italics throughout signify the following homologous parts: *m*, medulla; *cb*, cerebellum; *op*, optic lobes; *cr*, cerebrum and thalamus; *ol*, olfactory lobes. The series shows a progressive consolidation and enlargement of the brain in general, and of the cerebrum and cerebellum in particular, which likewise exhibit continually advancing structure in respect of convolution. In the case of Man, these two parts of the brain have grown to so great a size that they conceal all the other parts from the superficial points of view represented in the diagram.

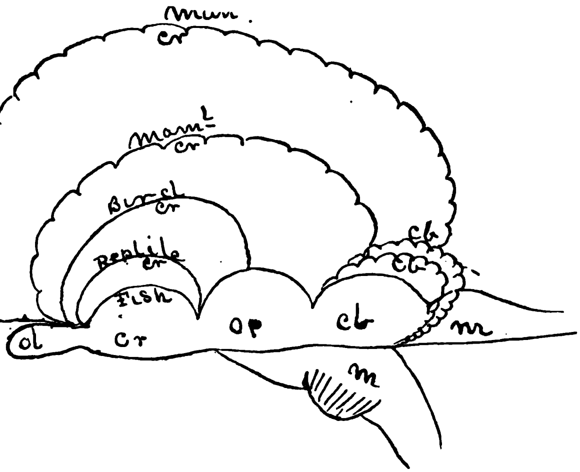


FIG. 87.—Ideal section through all the above stages. (After LeConte).

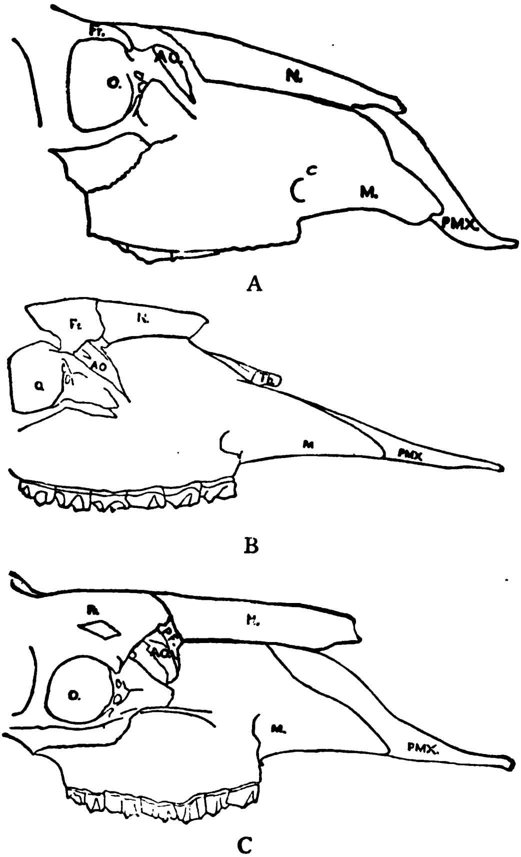


FIG. 88.—Skulls of—A, Canadian Stag; B, *Cervalces Americanus*; and C, Elk. (After Heilprin).

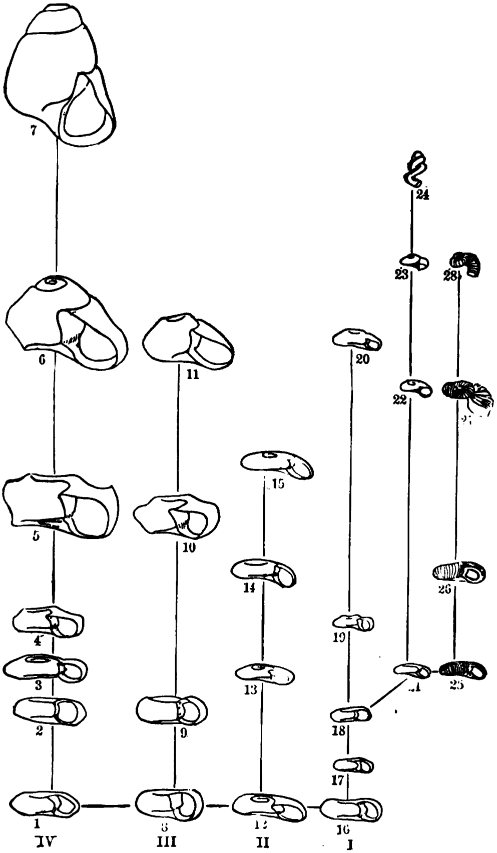


FIG. 89.—Transmutations of *Planorbis*. (After Hyatt).

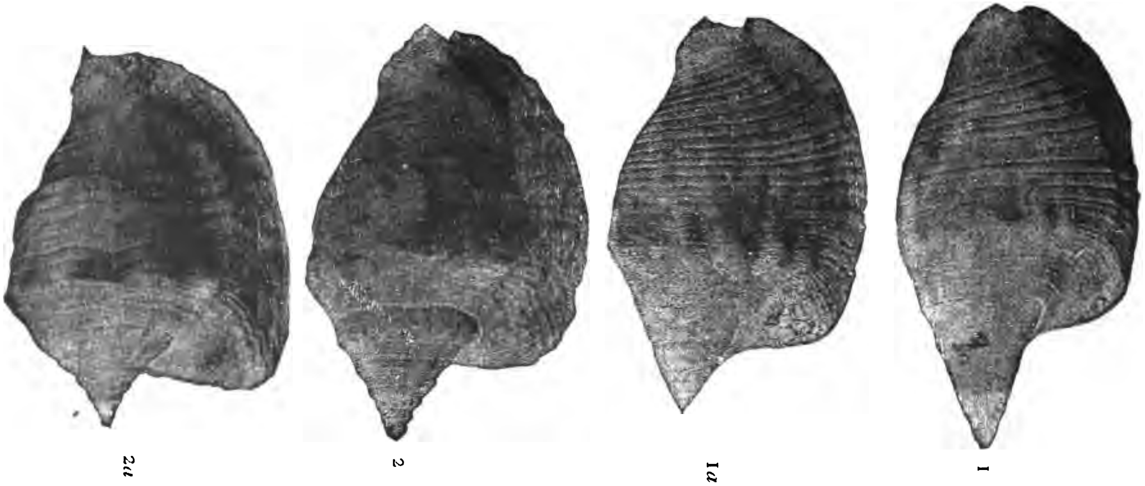


FIG. 90.—Transformation of *Strombus*. (After Heilprin). 1, 1*a*, *Strombus Leidy* (1, typical), Pliocene; 2, 2*a*, *Strombus accipitrinus* (2*a*, typical) Recent.

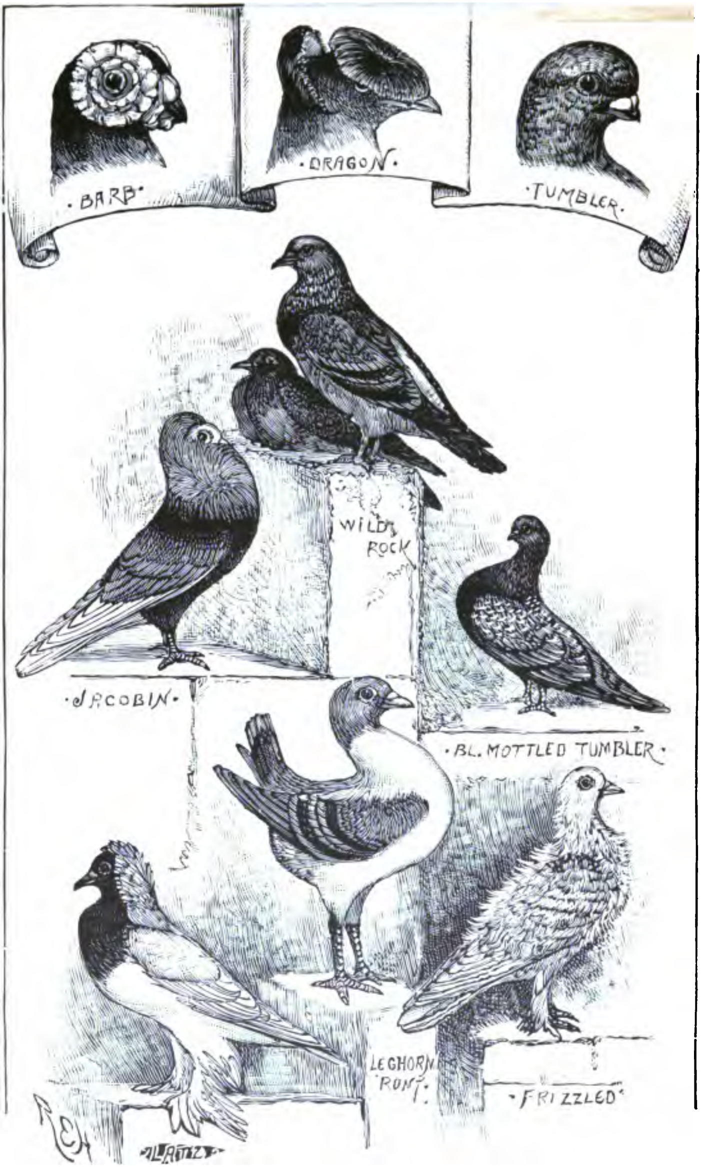


FIG. 91.—Pigeons. Drawn from life (prize specimens.)

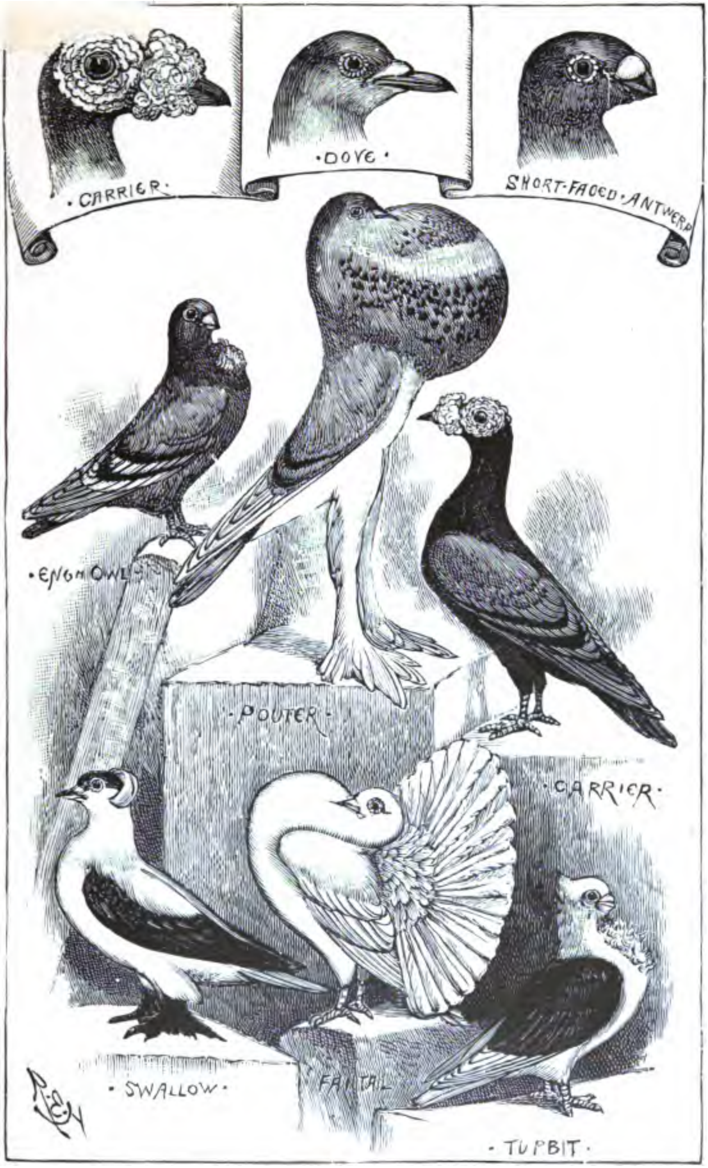


FIG. 92.—Pigeons, continued. Drawn from life (prize specimens).

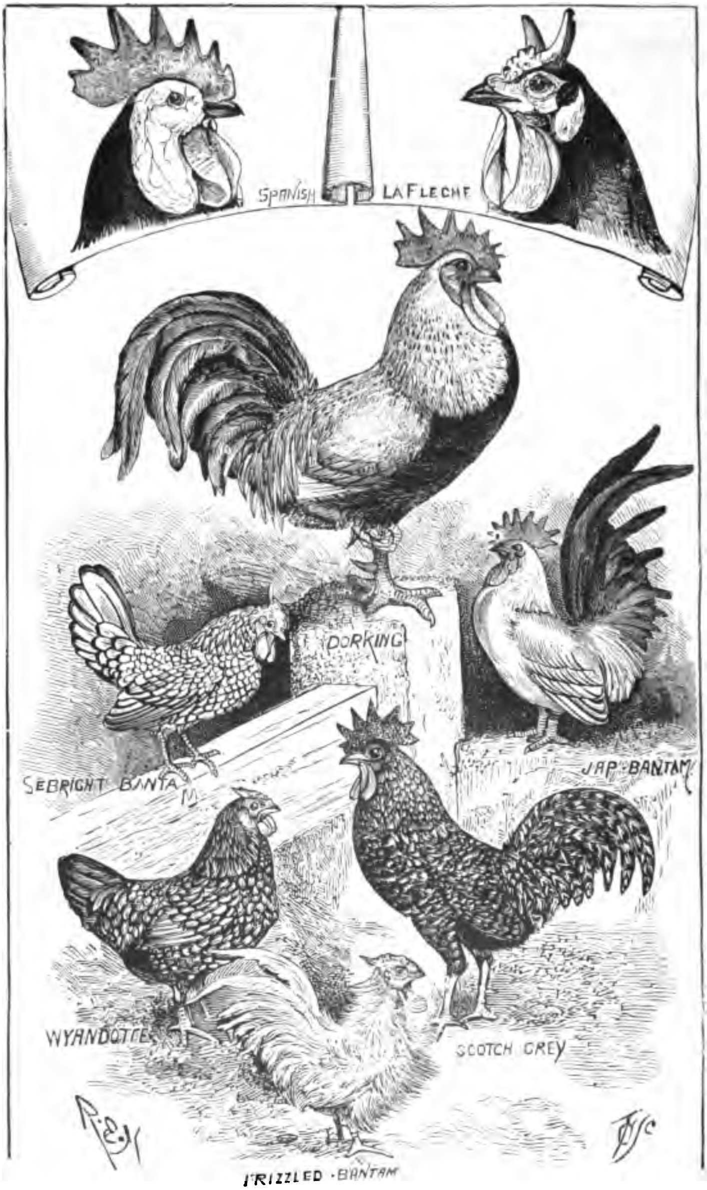


FIG. 93.—Fowls. Drawn from life (prize specimens).

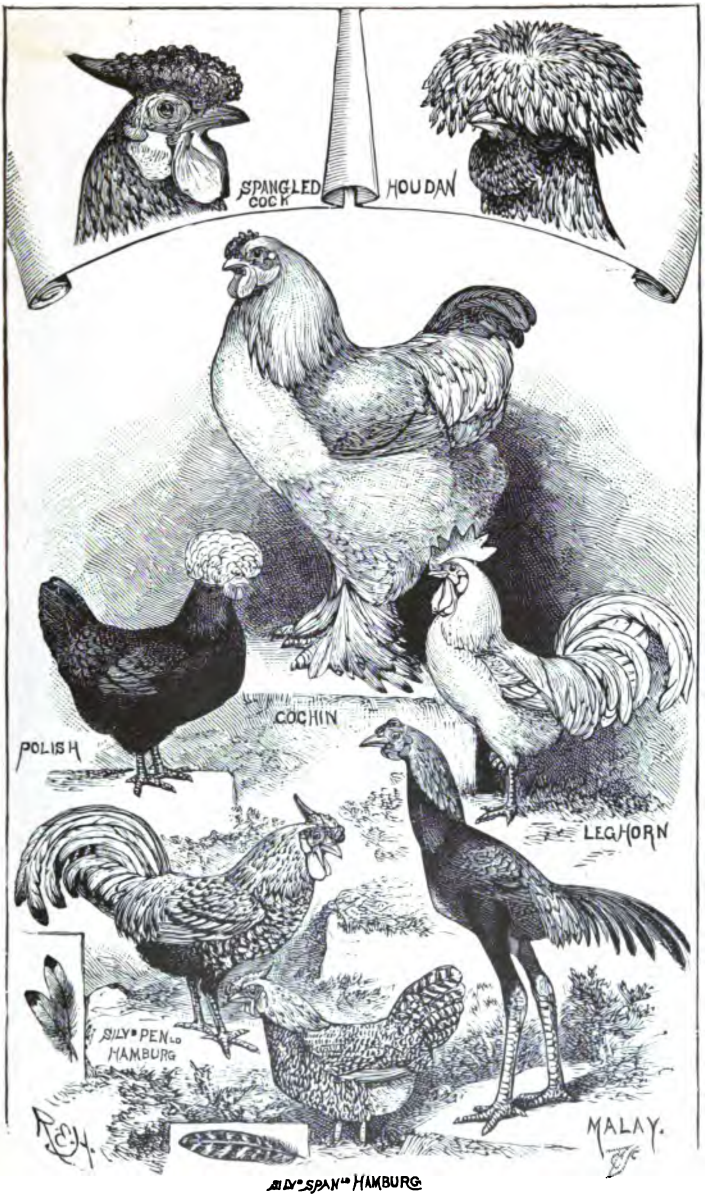


FIG. 94.—Fowls, continued. Drawn from life (prize specimens).

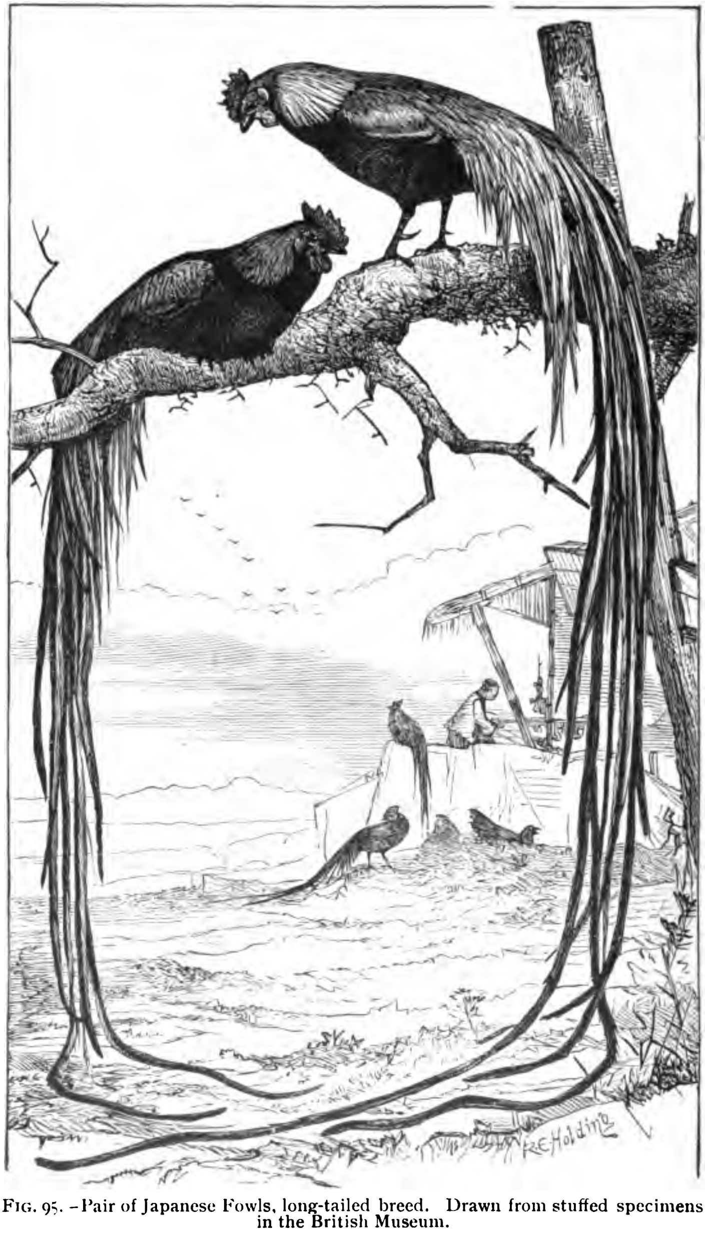


FIG. 95.—Pair of Japanese Fowls, long-tailed breed. Drawn from stuffed specimens in the British Museum.

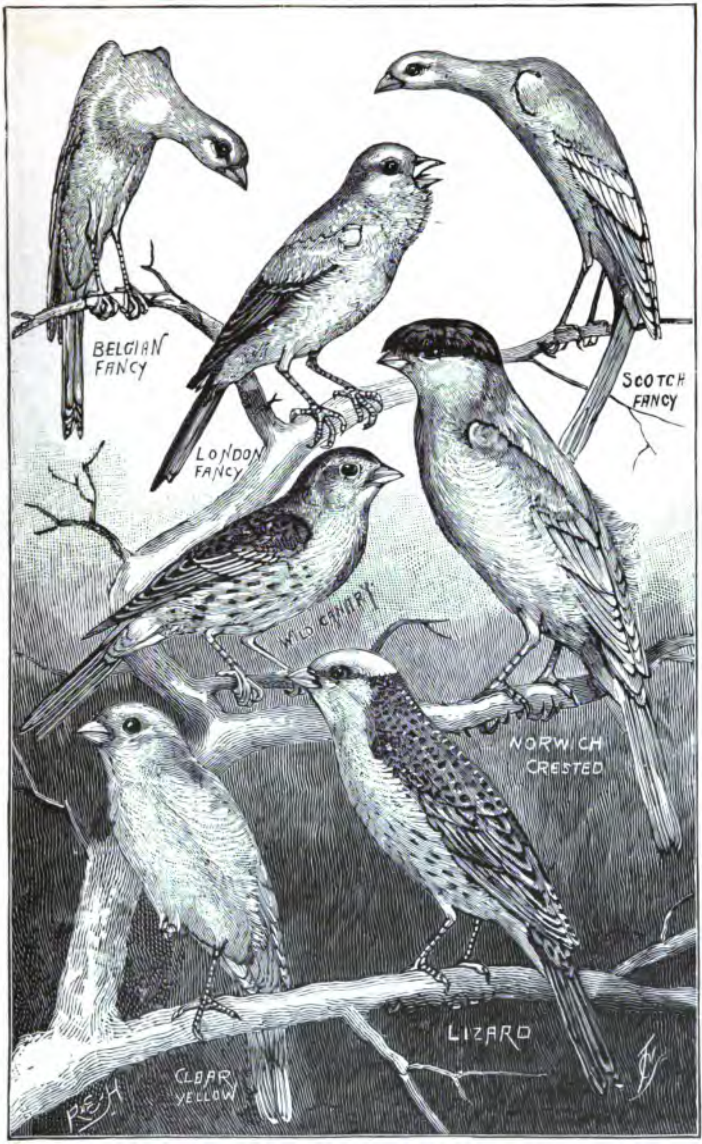


FIG. 96.—Canaries. Drawn from life (prize specimens).

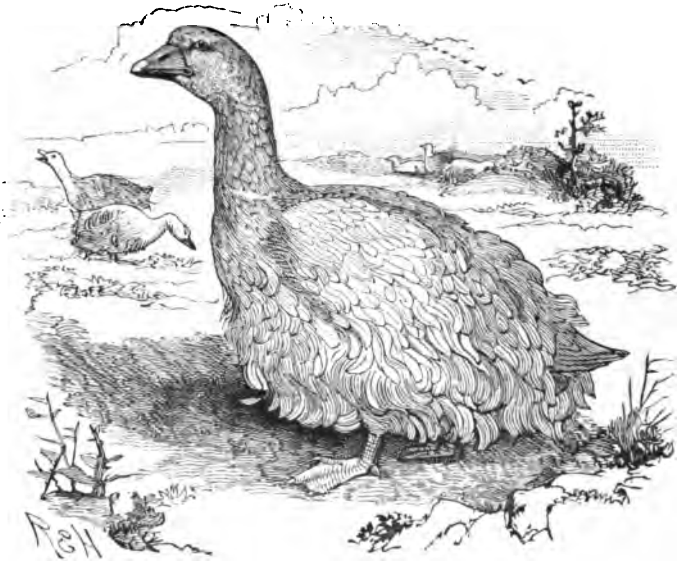


FIG. 97.—Sebastopol, or Frizzled Goose. Drawn from a photograph.

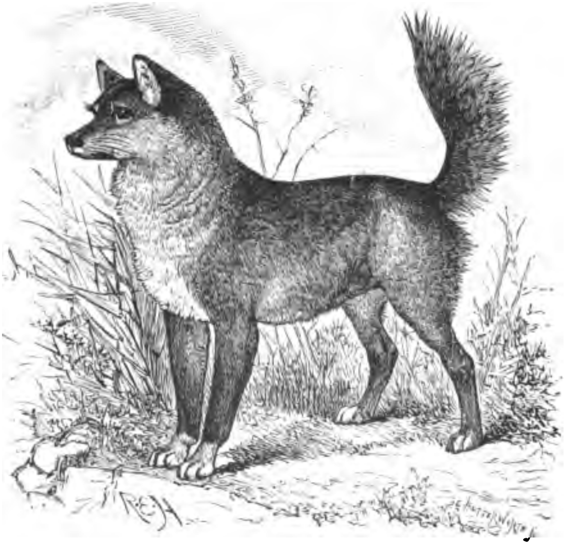


FIG. 98.—The Dingo, or wild dog of Australia, $\frac{1}{10}$ nat. size. Drawn from life (*Zoological Gardens*).

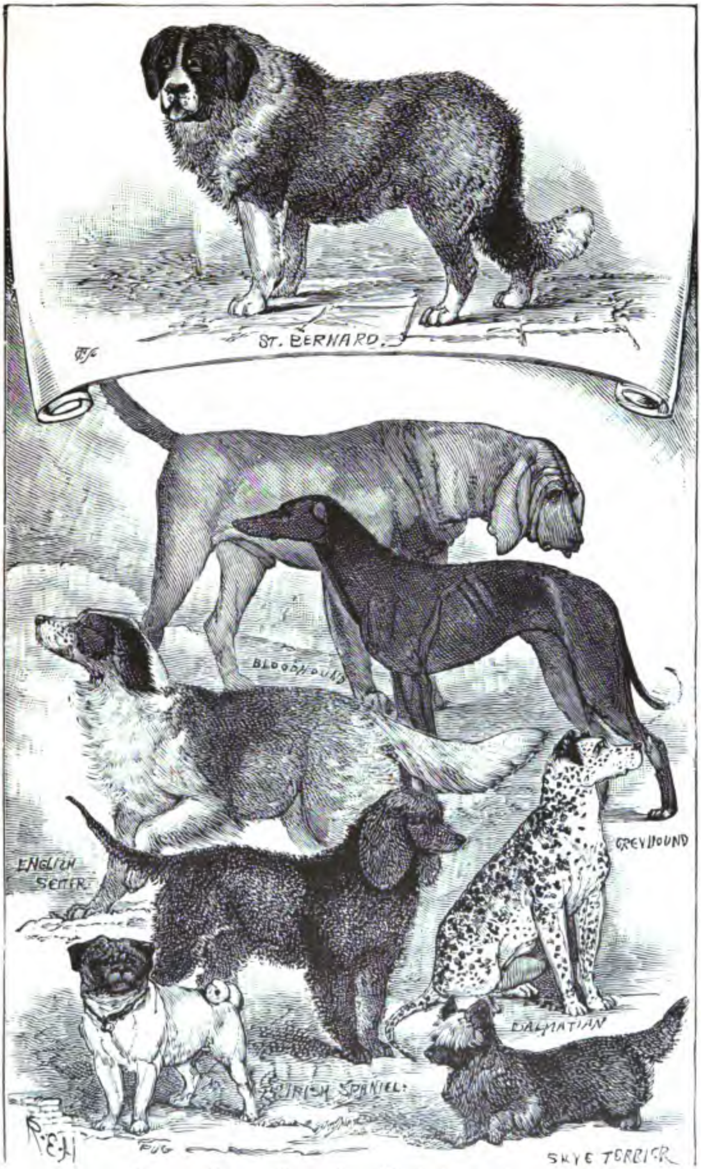


FIG. 99.—Dogs. Drawn from life (prize specimens).

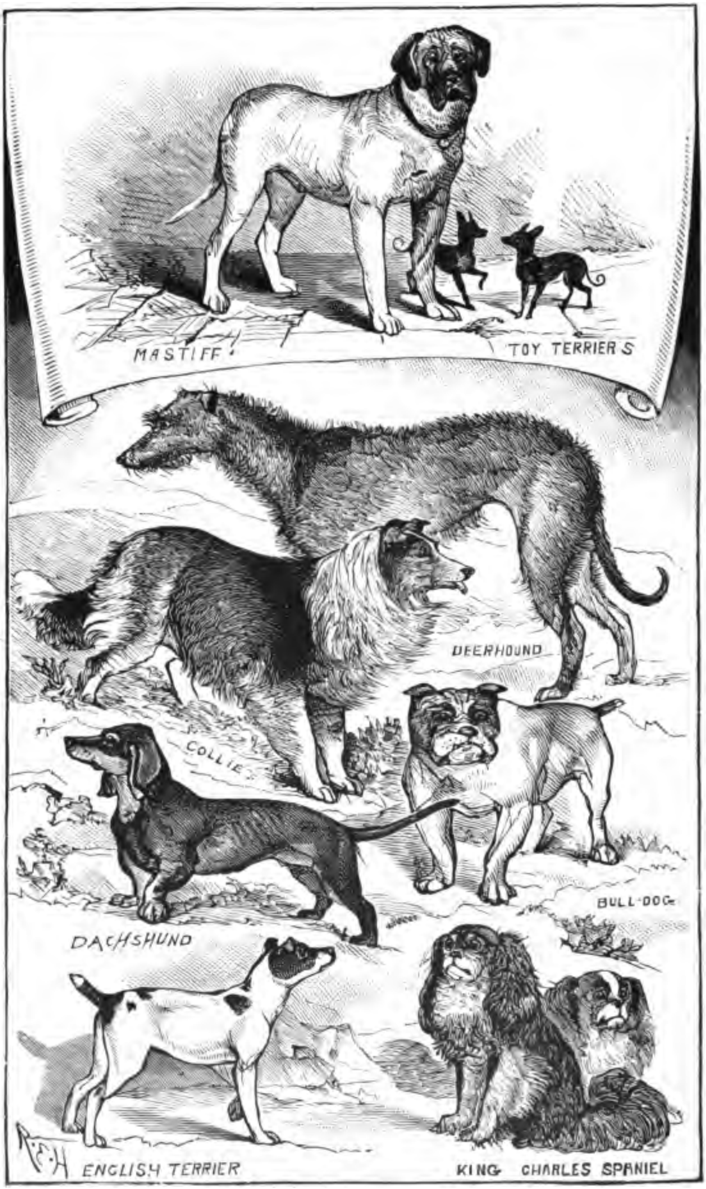


FIG. 100.—Dogs, continued. Drawn from life (prize specimens).

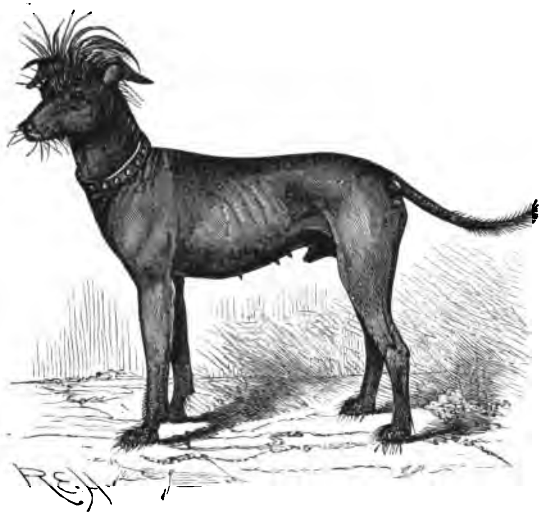


FIG 101.—The Hairless Dog of Japan, $\frac{1}{10}$ nat. size. Drawn from a photograph, kindly lent for the purpose by the proprietor.

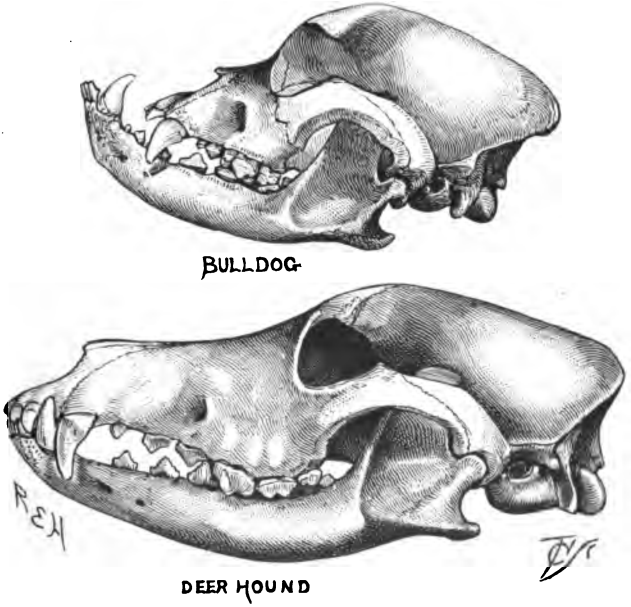


FIG. 102.—The skull of a Bull-dog compared with that of a Deerhound. Drawn from nature.

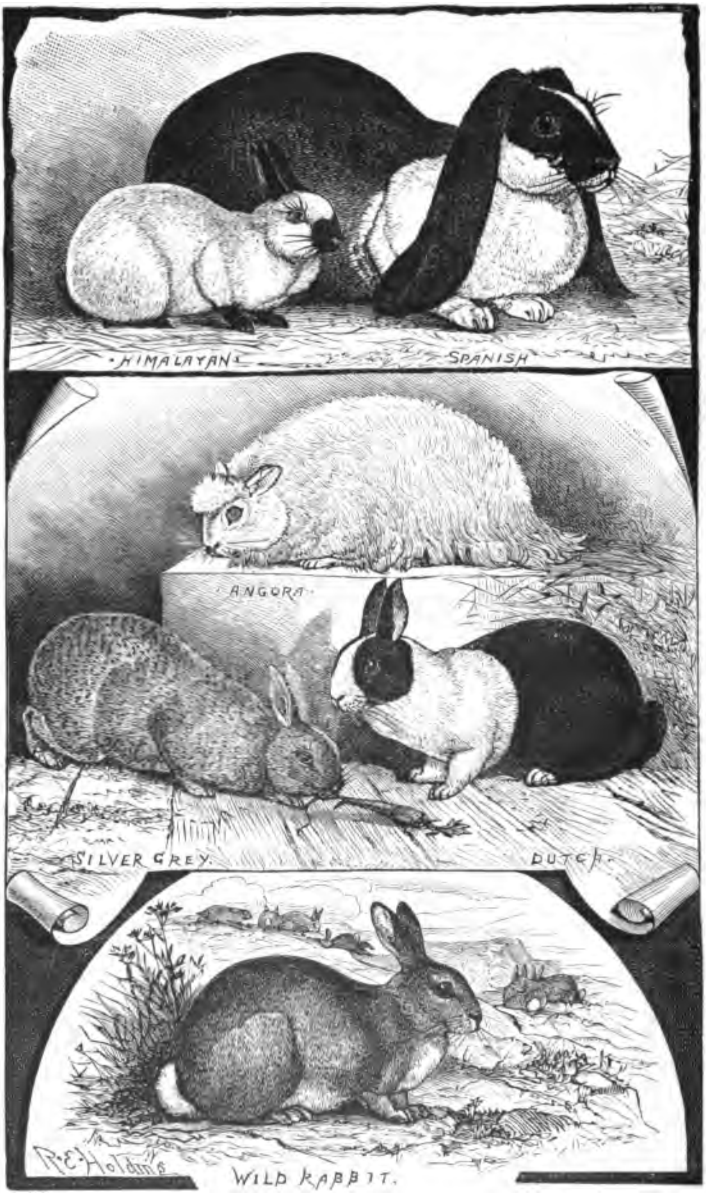


FIG. 103.—Rabbits. Drawn from life (prize specimens).

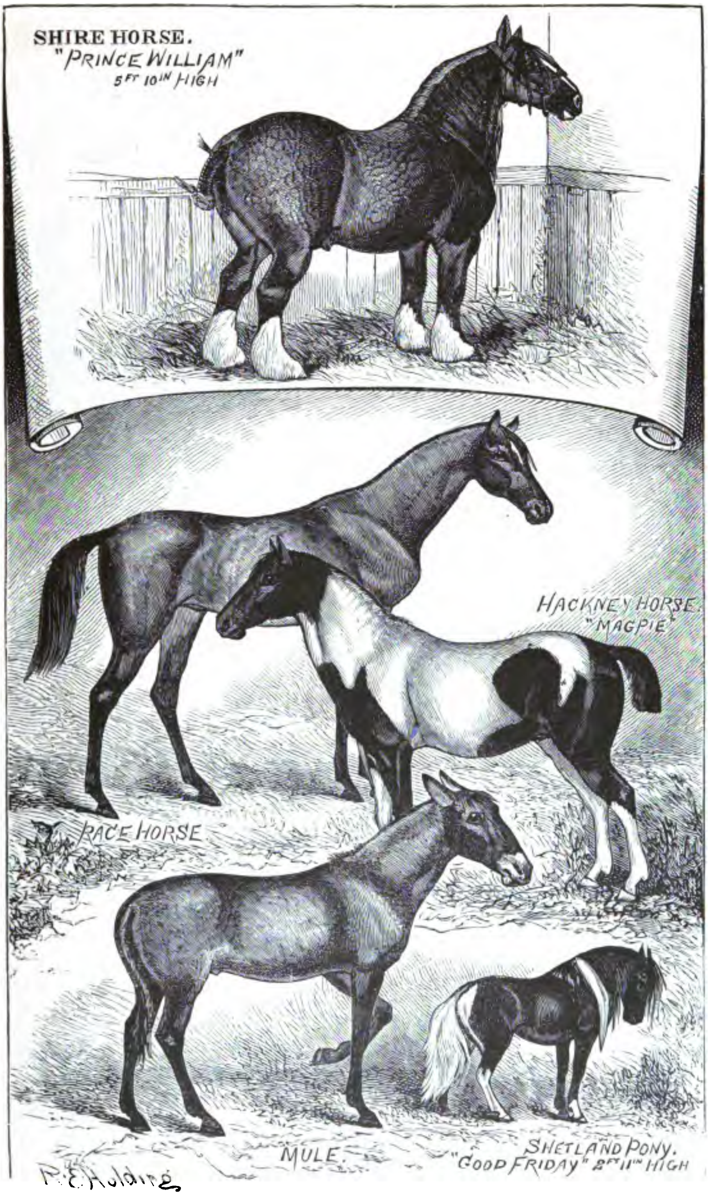


FIG. 104.—Horses. Drawn from life (prize specimens).

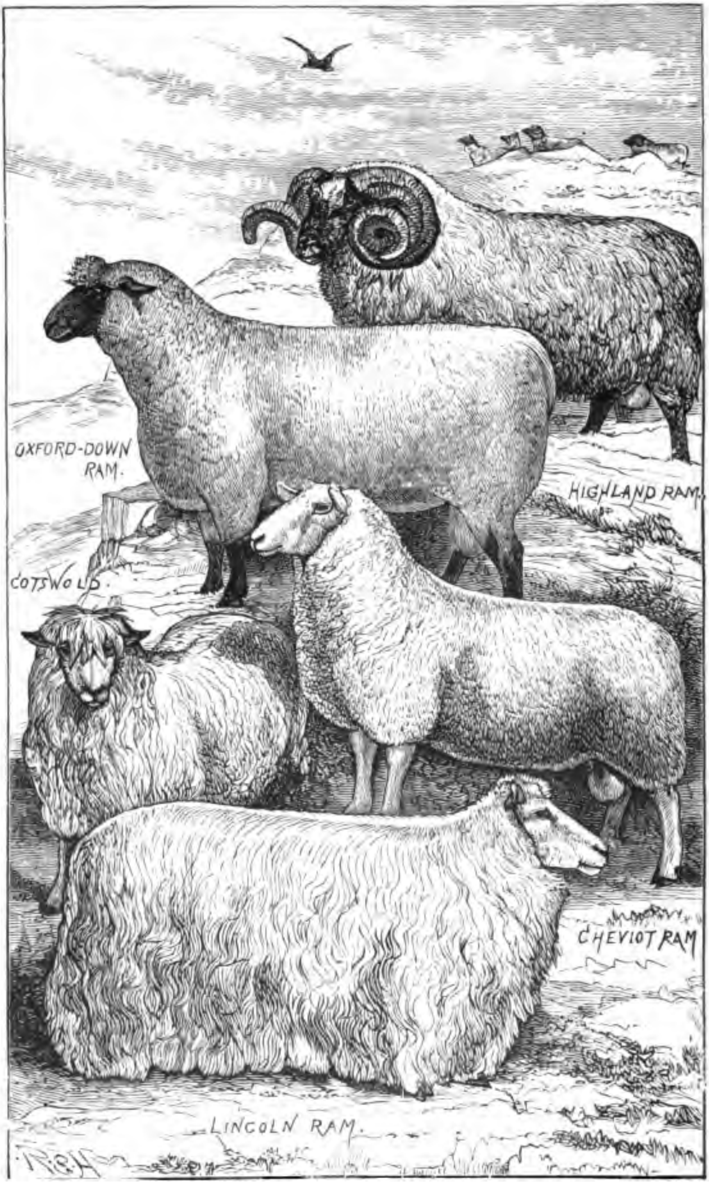

OXFORD-DOWN RAM.
HIGHLAND RAM.
COTSWOLD.
CHEVIOT RAM
LINCOLN RAM.
R.B.H.

FIG. 105.—Sheep. The illustrations are confined to British breeds. Drawn from life (prize specimens).

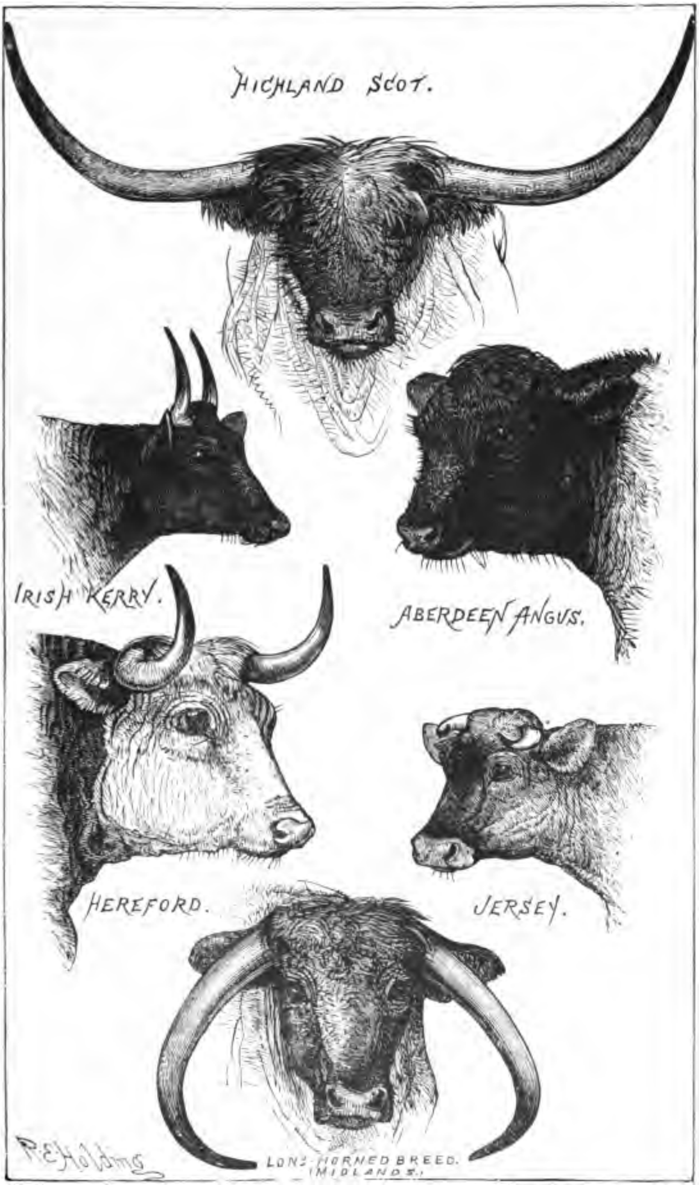

HIGHLAND SCOT.
IRISH KERRY.
ABERDEEN ANGUS.
HEREFORD.
JERSEY.
LONG HORNED BREED.
(MIDLANDS.)
R.E. Holding

FIG. 106.—Cattle. The illustrations are confined to British breeds. Drawn from life (prize specimens).

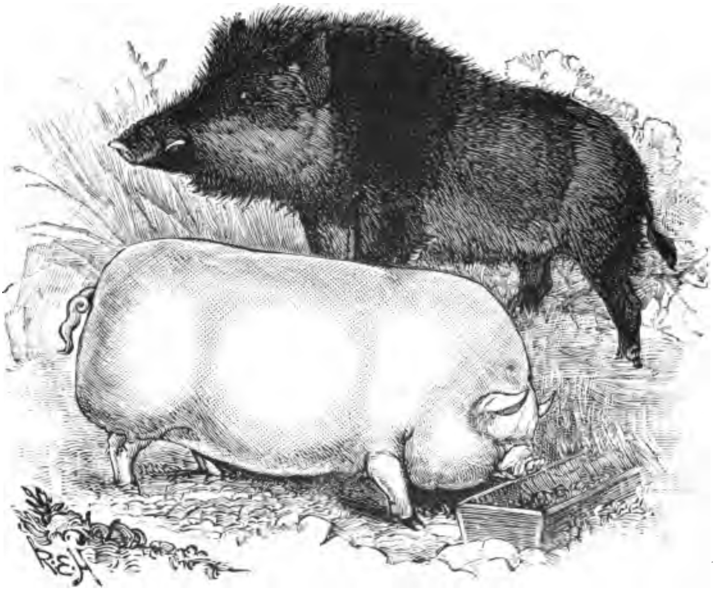


FIG. 107.—Wild Boar contrasted with a modern Domesticated Pig. Drawn from life (*Zoological Gardens*, and prize specimen).

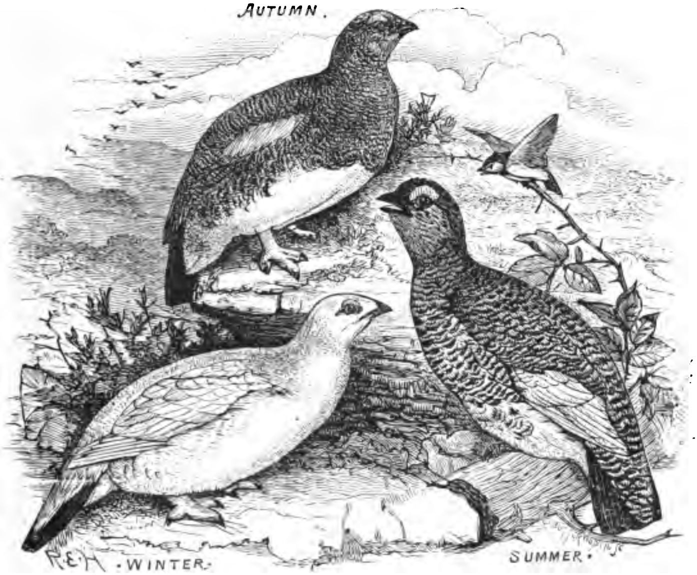


FIG. 108.—Seasonal changes of colour in Ptarmigan (*Lagopus mutus*). Drawn from stuffed specimens in the British Museum, $\frac{1}{6}$ nat. size, with appropriate surroundings supplied.

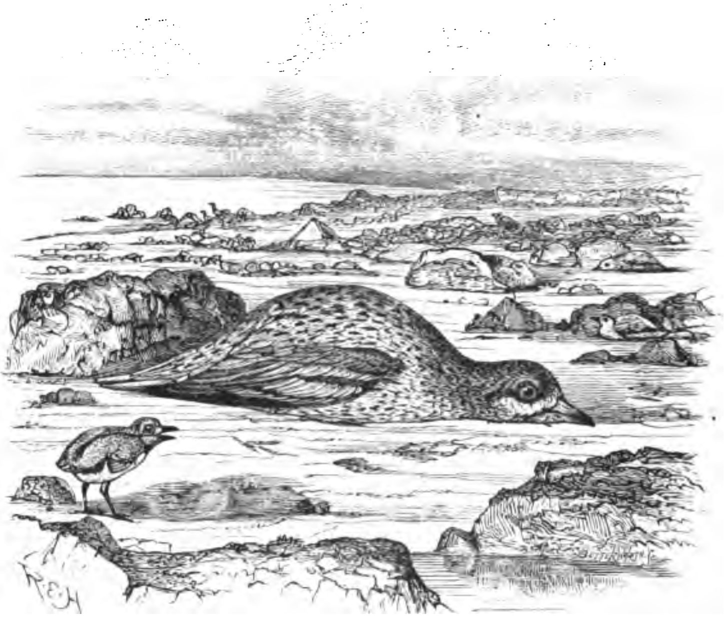


FIG. 109.—*Œdicnemus crepitans*, showing the instinctive attitude of concealment. Drawn from a stuffed specimen in the British Museum, $\frac{1}{6}$ nat. size, with appropriate surroundings supplied.

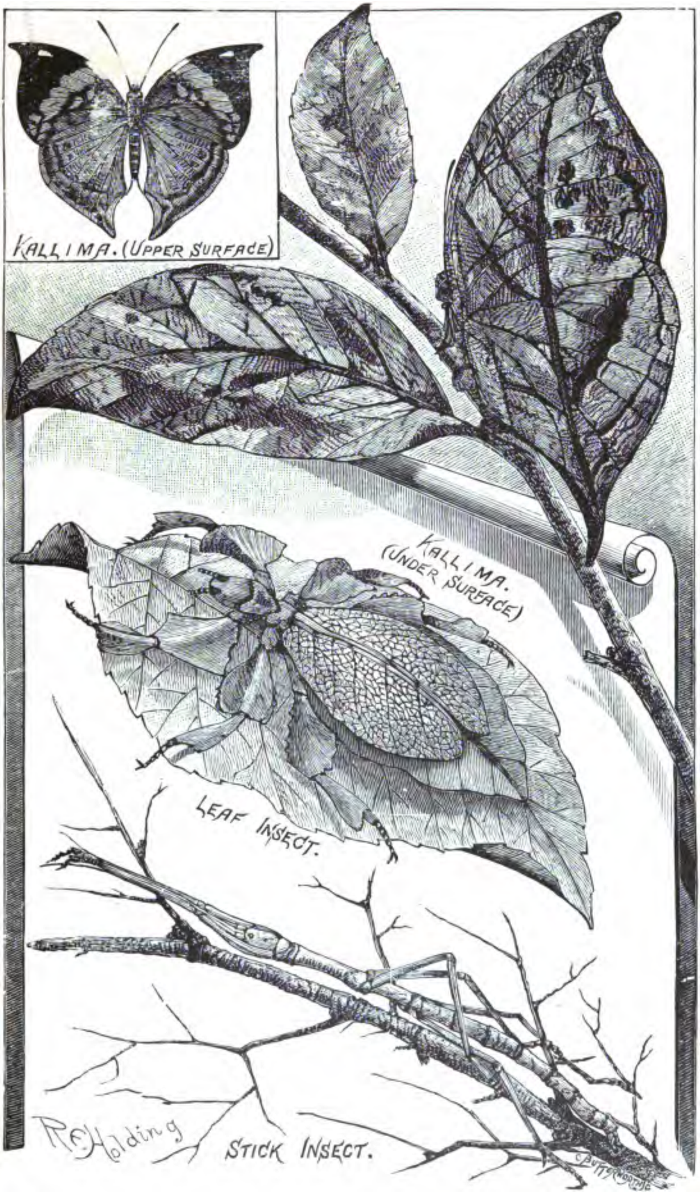


FIG. 110.—Imitative forms and colours in insects. Drawn from nature (*R. Coll. Surg. Mus.*)

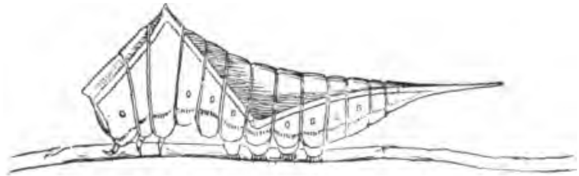


FIG. 111.—The larva of Puss Moth (*C. vinula*) when undisturbed; full fed; natural size.

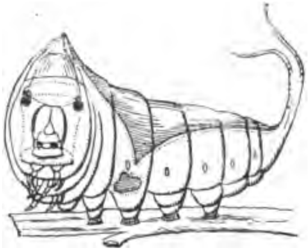


FIG. 112.—The larva of Puss Moth in its terrifying attitude after being disturbed; full-fed; natural size.

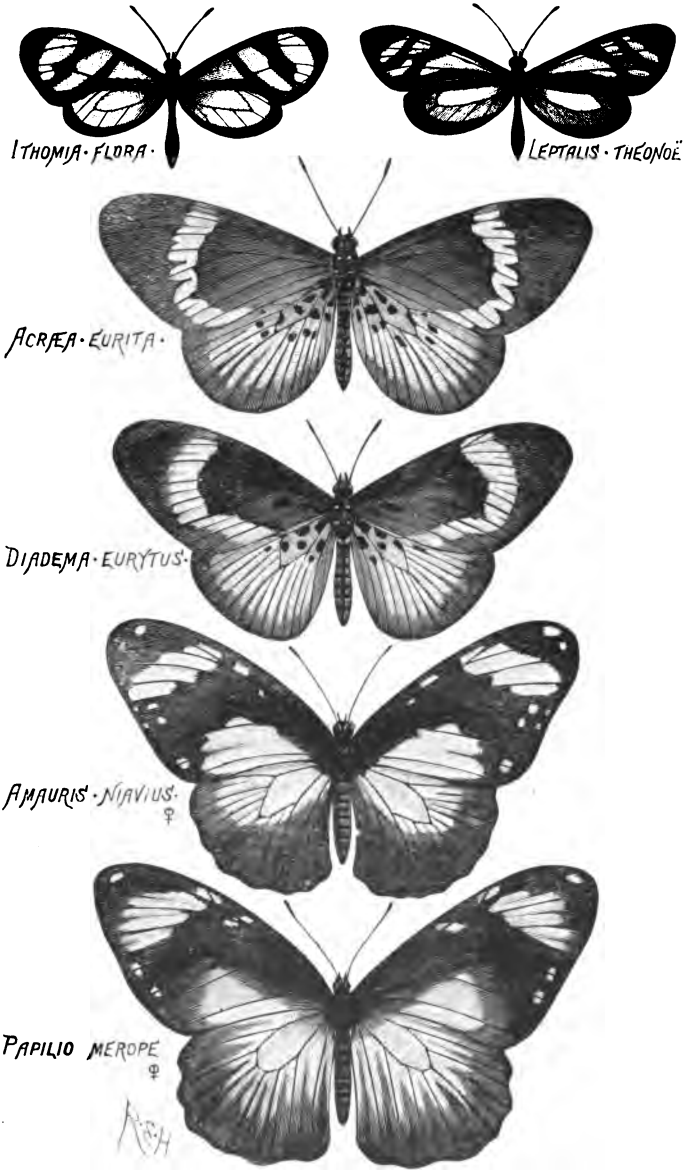


FIG. 113.—Three cases of mimicry. Drawn from nature: first two pairs nat. size, last pair ⅔ (*R. Coll. Surg. Mus.*)

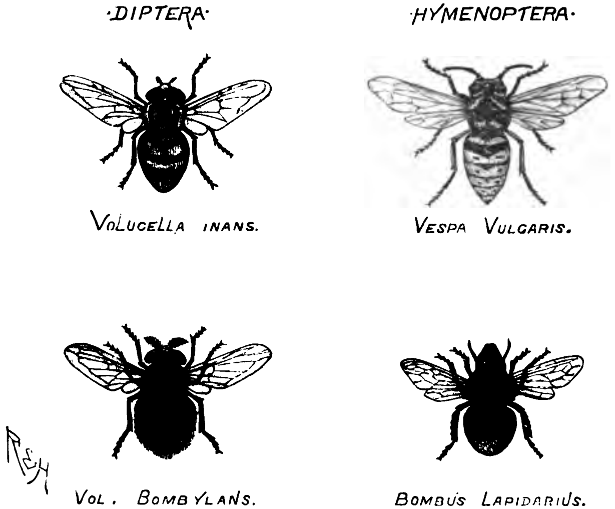

·DIPTERA·
·HYMENOPTERA·
VoLuceLLA INANS.
VESPA VULGARIS.
VOL. BOMBYLANS.
BOMBUS LAPIDARIUS.
REH

FIG. 114.—Two further cases of mimicry; flies resembling a wasp in the one and a bee in the other. Drawn from nature: nat. size (*R. Coll. Surg. Mus.*)

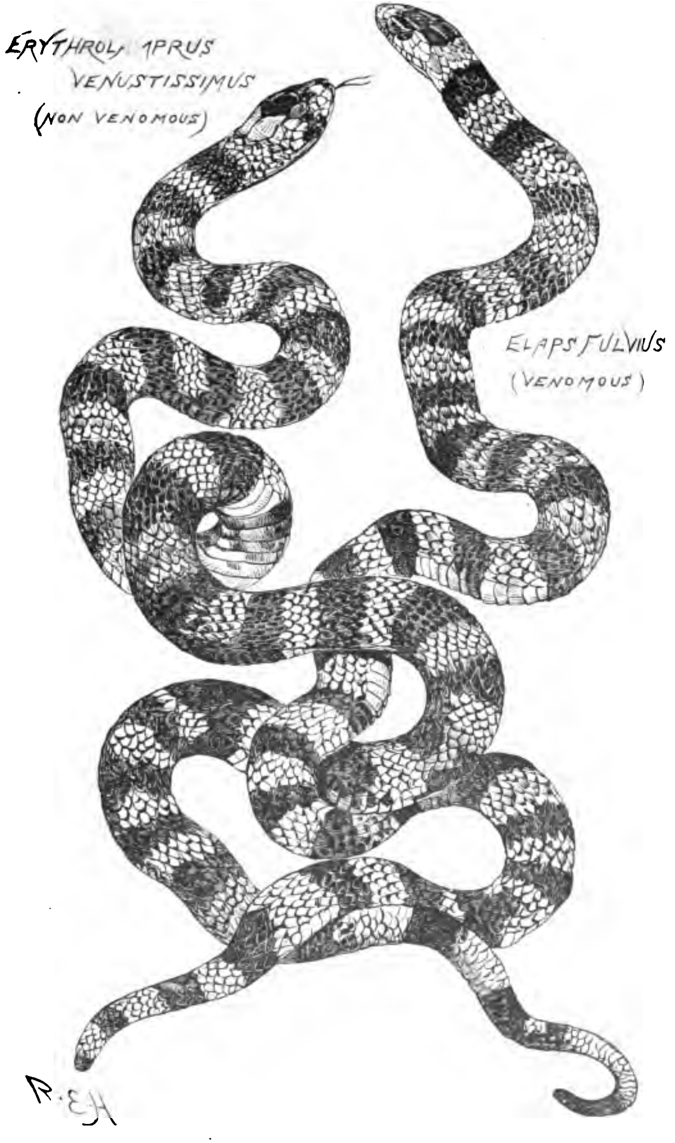


FIG. 115.—A case of mimicry where a non-venomous species of snake resembles a venomous one. Drawn from nature: ⅓ nat. size (*R. Coll. Surg. Mus.*).

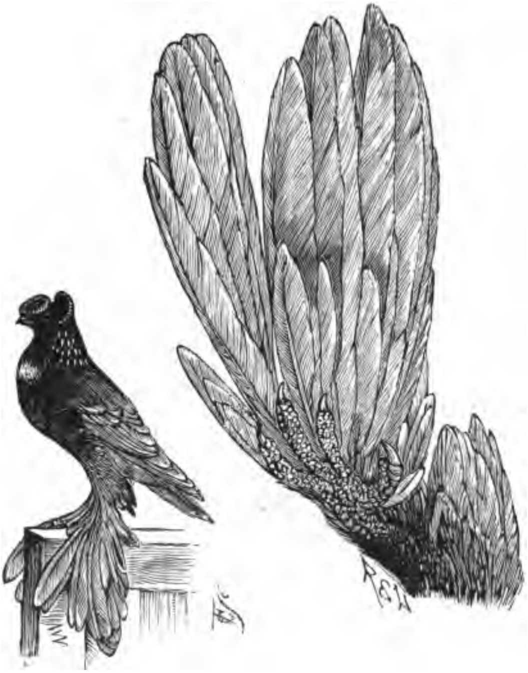


FIG. 117.—Feather footed pigeon. Drawn from nature.

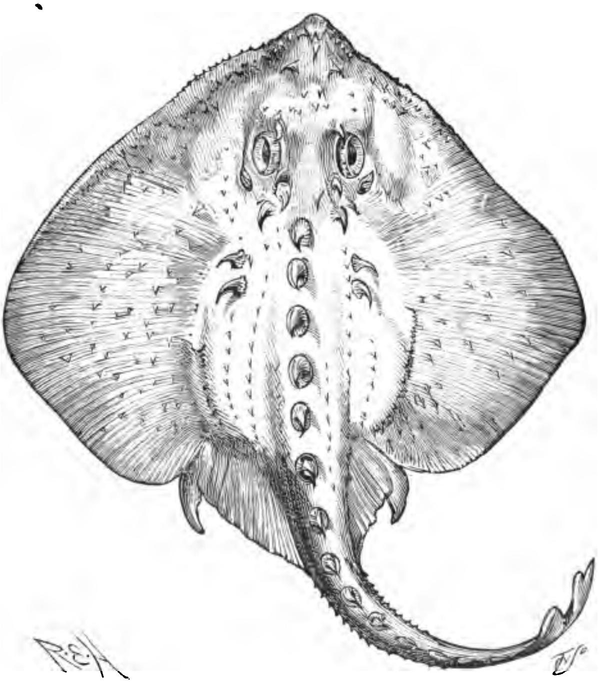


FIG. 118.—*Raia radiata*, representing the life size of the youngest individual in which muscle fibres have been found developing into electric cells.

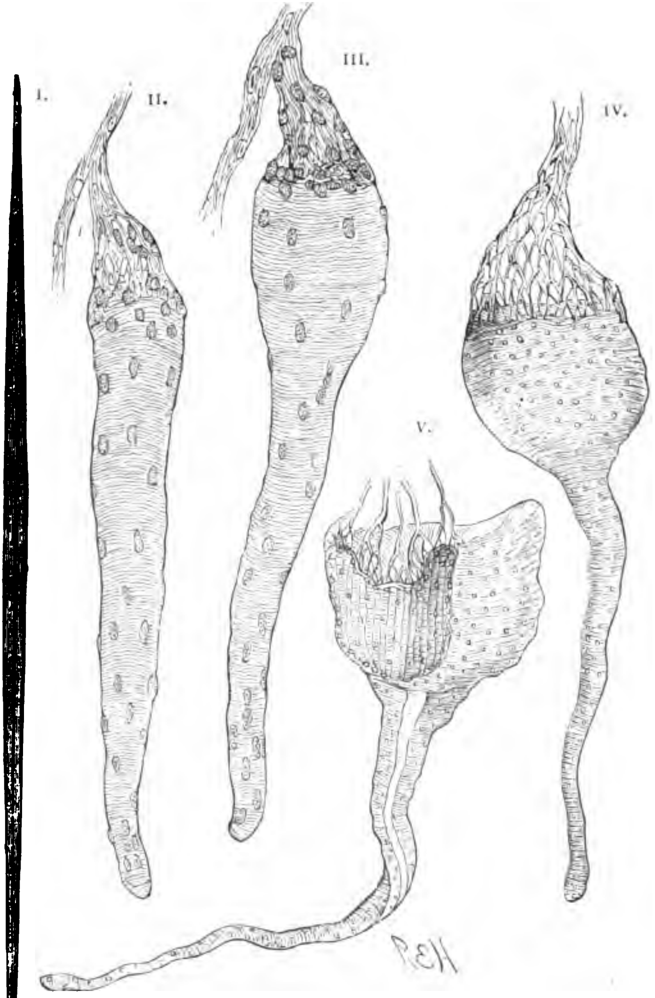


FIG. 119.—Electric organ of the Skate. The left-hand drawing (I) represents the entire organ (natural size) of a full-grown *R. radiata*. This is a small skate, which rarely exceeds 50 centms. in length; but in the large *R. batis*, the organ may exceed two feet in length. The other drawings represent single muscle-fibres in successive stages of transition. In the first of the series (II) the motor plate, and the nerves connected with it, have already been considerably enlarged. In the other three specimens, the fibre becomes more and more club-like, and eventually cup-like. These changes of shape are expressive of great changes of structure, as may be seen in the last of the series (V), where the shallow cup is seen in partial section. The electric plate lines the concavity of the cup, and is richly supplied with nerves (only a few of which are represented in the last drawing): the thick walls of the cup are composed of muscular fibres, the striation of which is distinctly visible.

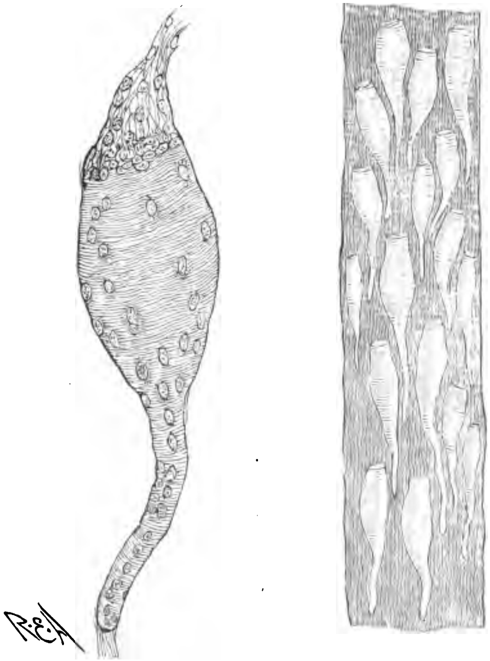


FIG. 120.—Electric cells of *Raia radiata.* The drawing on the left represents one of the clubs magnified, as in the preceding woodcut. The drawing on the right represents a number of these clubs, less highly magnified, *in situ.*

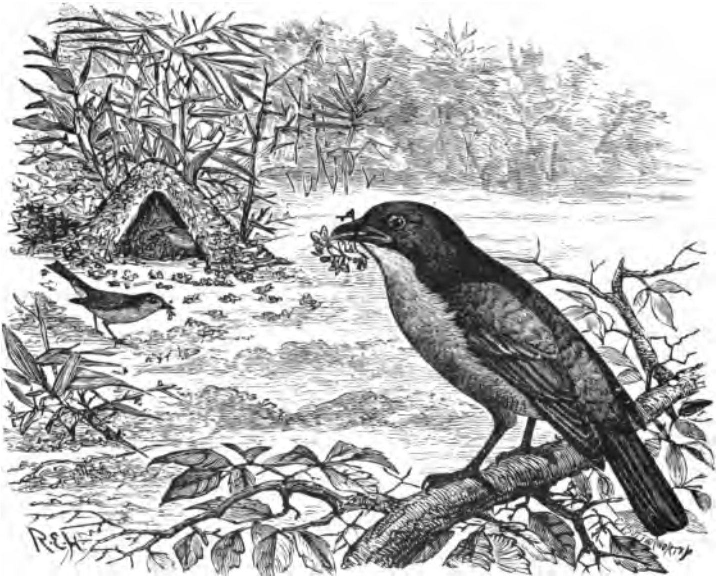


FIG. 121.—The Garden Bower-bird (*Amblyornis inornata*). Reduced from *Gould's Birds of New Guinea* to ½ nat. size.

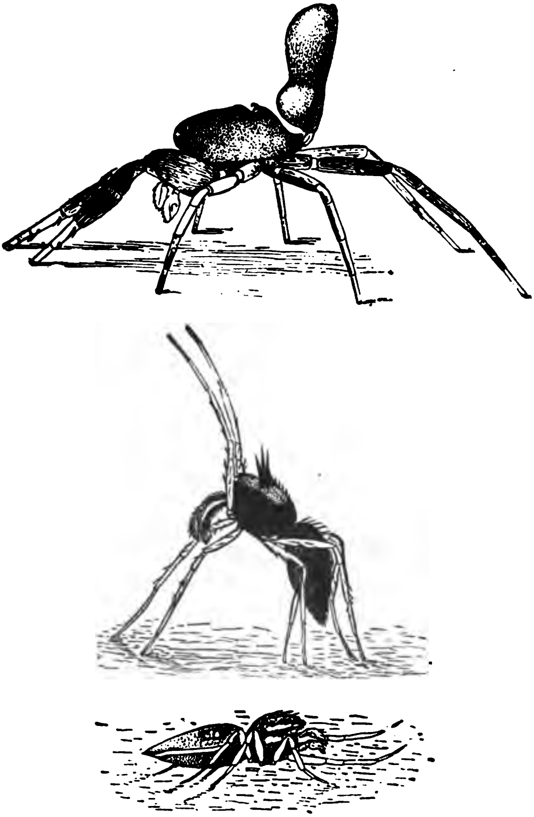


FIG. 122.—Courtship of Spiders. A few examples of some of the attitudes adopted by different species of males when approaching their females. (After Peckham).

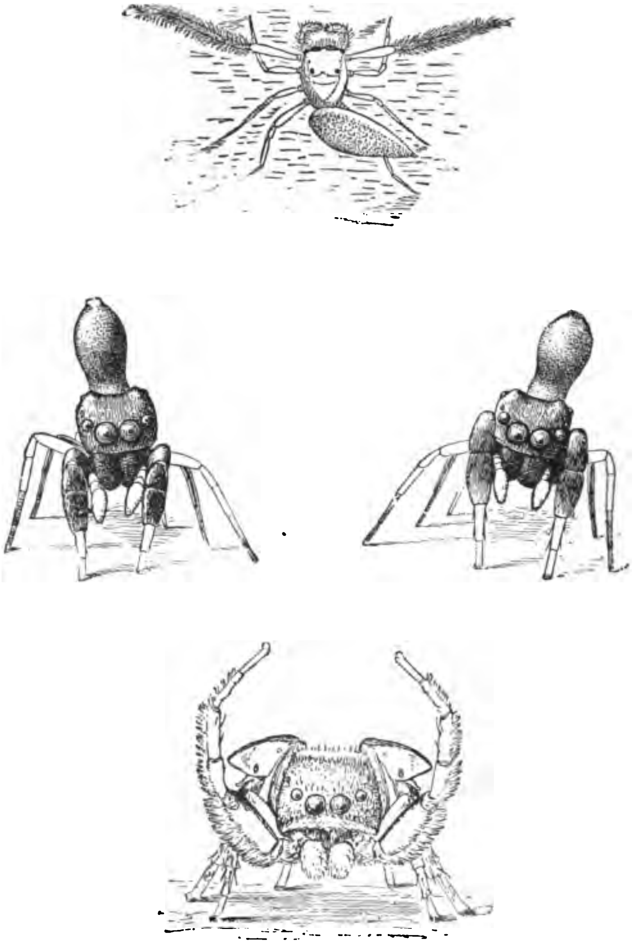


FIG. 123.—Courtship of Spiders. Continued from Fig. 122, similarly showing some of the attitudes of approach adopted by males of yet other different species. (After Peckham).

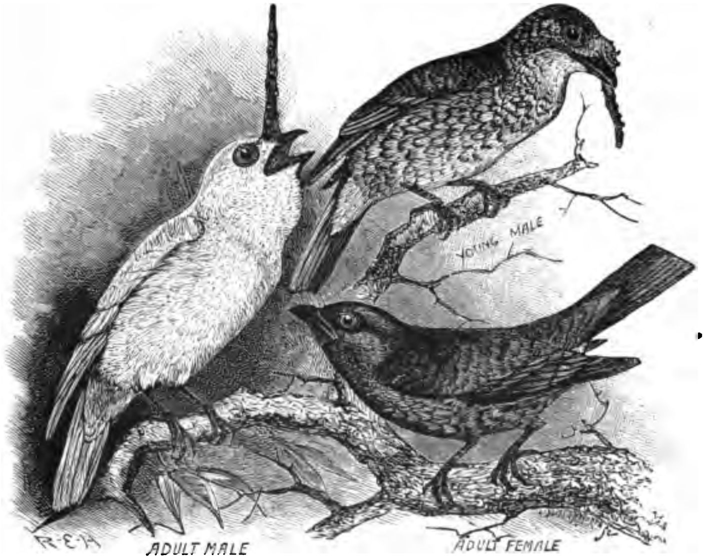


FIG. 124.—The Bell-bird (*Chasmorhynchus niveus*, ¼ natural size). Drawn from nature (*R. Coll. Surg. Mus.*) In the drawing of the adult male the ornamental appendage is represented in its inflated condition, during courtship; in the drawing of the young male it is shown in its flaccid condition.

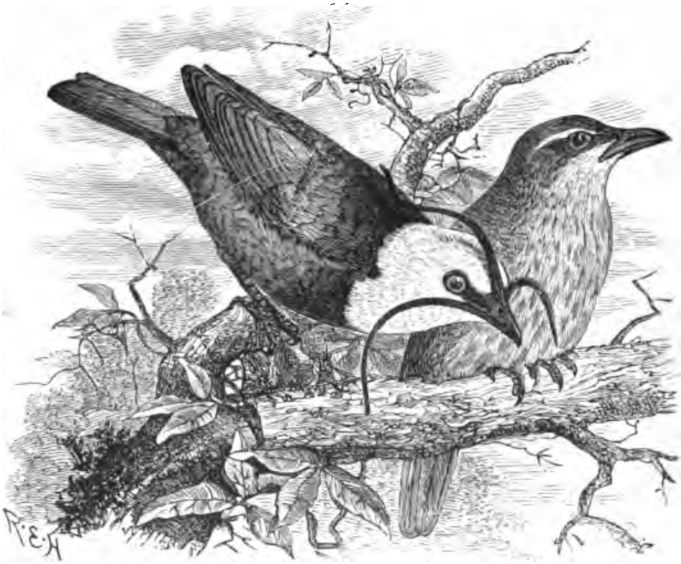


FIG. 125.—*C. tricarunculatus*, ¼ natural size. Copied from the *Ibis*. The ornamental appendages of the male are represented in a partly inflated condition.

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